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SURVIVAL, GROWTH AND RECRUITMENT OF LARVAL AND JUVENILE RAZORBACK SUCKER (*Xyrauchen texanus*) INTRODUCED INTO FLOODPLAIN DEPRESSIONS OF THE GREEN RIVER, UTAH

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SURVIVAL, GROWTH AND RECRUITMENT OF LARVAL AND JUVENILE RAZORBACK SUCKERS (Xyrauchen texanus) INTRODUCED INTO FLOODPLAIN DEPRESSIONS OF THE GREEN RIVER, UTAH

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Final Report

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The opinions and recommendations expressed in this report are those of the authors and do not necessarily reflect the views of the Utah Division of Wildlife Resources, the Recovery Implementation Program or any of its cooperating members. Mention of trade names, commercial products, or firms and businesses does not constitute endorsement or recommendation for use by the authors, Utah Division of Wildlife Resources, the Recovery Implementation Program or any of its cooperating members.

LIST OF KEYWORDS

Green River, floodplain depressions, flows, flood, non-native fish, native fish, razorback sucker, larval fish, Age-1, survival, growth, stock, water quality

EXECUTIVE SUMMARY

Floodplains are presumed to be important rearing habitat for the endangered razorback sucker *(Xyrauchen texanus)*. To help recover this endemic Colorado River Basin species, the Upper Colorado River Endangered Fish Recovery Program implemented a floodplain acquisition and enhancement program. Levee removal was initiated in 1996 as one component of this floodplain restoration program. The goal of the Levee Removal Study was to evaluate the system responses to levee removal and make specific recommendations concerning the value of floodplain/river reconnecting for endangered species (specifically razorback sucker) recovery. Razorback suckers were not collected in floodplains during the Levee Removal Study, which may be attributed to the low razorback sucker population in the river. Therefore, data specific to razorback sucker use of the floodplain was not available. This was not a stocking evaluation, rather the stocked fish were used as a tool to learn how razorback sucker may use the floodplains. Age-1 and larval razorback sucker were stocked into depression floodplain wetland habitats along the Middle Green River in northeastern Utah. Age-1 razorback suckers were stocked during the spring of 1999 and 2000 into three floodplain depressions. At the time of stocking each floodplain site contained numerous nonnative fish including: black bullhead (*Ictalurus melas*), fathead minnow (*Pimephales promelas*), green sunfish (*Lepomis cyanellus*) and carp (*Cyprinus carpio*). The goal of this study was to evaluate if floodplain depressions containing nonnative fishes can still provide effective rearing habitat for naturally produced (wild) razorback sucker. Specific objectives intended to address questions remaining from the Levee Removal study include:

A) Determine larval razorback sucker survival rates in nonnative fish dominated environments.
B) Determine growth rates of larval and juvenile razorback sucker in nonnative dominated environments.
C) Determine if razorback sucker leave floodplain depressions and recruit to the river.
D) Assuming C is true, determine how long fish use floodplain depressions before leaving and what factors trigger movement from floodplain wetlands for the river.

Survival of larval razorback sucker stocked into the floodplains was not detected by sampling. The exact cause of larval razorback sucker mortality in the sites is unknown, however, some possibilities include; predation, insufficient stocking densities, poor water quality and failure of stocked larval fish to use available food resources.

Survival of age-1 razorback sucker stocked in 1999 was estimated for each study site after the first growing season (fall 1999) and after one year (spring 2000). Estimated survival for fall 1999 ranged from 37% to 57% During spring 2000, overwinter survival was estimated at 56% to 73%. Razorback sucker summer survival was significantly reduced in 2000 because of below average spring flows and drought conditions that persisted through the summer.

Razorback sucker grew from 110mm, 111mm and 96mm averages at stocking to 317mm, 341mm and 310mm averages in September/October for the three sites. Weight gains averaged 336g, 442g, and 347g in the three sites. Growth rates averaged from 1.3 mm/day to 2.2 grams/day.

Following the second growing season, fish stocked in 1999 averaged 409mm/722 grams to 410mm/863 grams. Growth rates for the second growing season averaged 0.3mm/day and 1.2 g/day to 0.5mm/day and 2.6 g/day. Growth rates for age-1 fish stocked into Baeser Bend in the spring of 2000 were similar to 1999 growth rates. This far exceeded the growth of a control group of fish that were held at the Ouray hatchery.

Although conditions were not ideal, and nets were not entirely effective, some data on razorback sucker movement from the sites was collected. Only two razorback sucker were caught leaving the sites during the first connection with the river following stocking, suggesting age-1 fish preferred to remain in the sites. Survival estimates confirm that most fish remained in the sites after this first river connection, and therefore for at least one growing season. Significantly more razorback sucker left the floodplain the second year. During connection in 2000, 31 razorback sucker were caught in outgoing traps at Baeser Bend, 10 at Above Brennan, and one at The Stirrup. Considerably more movement occurred than was measured in these nets. Numerous floodplain stocked razorback sucker that were not captured in outgoing traps were captured in the river. Floodplain razorback sucker caught with river sampling totaled 41 in 2000 and 148 in 2001.

Stocking age-1 razorback sucker into floodplain depressions can potentially contribute healthy fish to the river population. Perhaps more importantly, this study demonstrated that floodplain depressions containing an abundant non-native fish community can still provide viable rearing habitat for wild razorback sucker. Efforts to determine if larval razorback sucker can survive in nonnative fish dominated floodplain habitat should continue. The following recommendations are made:

1. Continue studies to quantify larval razorback sucker survival to recruitment in floodplain sites. Efforts should focus on enhancing larval fish entrainment into the best floodplains, testing survival following a reset of nonnative fish populations, determining larval densities necessary to survive predation, options for nonnative fish control, and quantify other sources of mortality such as water quality and food availability. Entrainment and survival of larval razorback sucker in floodplain habitats represent one of the critical links in self-sustaining razorback sucker populations.
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INTRODUCTION

Since the construction of Flaming Gorge Dam, the magnitude and duration of spring peak flows in the Green River have decreased (Muth et al. 2000). This has reduced the frequency and duration of the river-floodplain connection. Floodplains are presumed to be important rearing habitat for the endangered razorback sucker *(Xyrauchen texanus*) (Wydoski and Wick 1998; Muth et al. 1998; Lentsch et al. 1996a). Elevated temperatures, nutrients and light intensities combine to make floodplain wetlands areas of high primary productivity (Birchell et al. 2002; Wydoski and Wick 1998; Lentsch et al. 1996a; Cooper and Severn 1994), and zooplankton density (fish food items) is also high.

Wydoski and Wick (1998) summarized data collected from zooplankton studies conducted in the Upper Colorado River Basin. Zooplankton densities (mean number of organisms/liter) were lowest in the main channel (0 - 1.3), higher in backwaters (0 - 13.1) and highest in floodplain habitats (4.2 - 81.5). The minimum quantity of food required by razorback sucker larvae to survive following swim-up is 30 - 60 shrimp nipple per fish per day (Peepuls and Mickey 1992 in Wydoski and Wick 1998). The highest density of zooplankton commonly occurs in floodplains along the middle Green River, rarely in backwaters, and never in the main channel (Birchell et al. 2002; Wydoski and Wick 1998). Reproduction by razorback sucker occurs in the spring during peak flows when highly productive floodplain habitats are accessible to fish (Muth et al. 1998). This seasonal timing of razorback sucker spawning, and drift, indicates possible adaptation for using floodplain habitats (Muth et al. 1998).

The capture of 73 juvenile razorback sucker in a managed floodplain wetland

(Old Charley Wash) dominated by nonnative fish provides evidence supporting the importance of floodplain habitat to razorback sucker (Modde 1996, 1997). These captures represent one of the few times juvenile razorback sucker have been captured despite known spawning (Modde 1996, 1997; Muth et al. 1998). However, survival to recruitment (i.e., adulthood) was not demonstrated in the Old Charley Wash study. Lack of survival beyond the larval stage to adulthood has been attributed to habitat loss and modification and predation by nonnative fishes (Muth et al. 1998; Wydoski and Wick 1998; Lentsch et al. 1996b).

Based on the assumption that floodplain wetlands provide critical rearing habitat for razorback sucker, the Recovery Program initiated the Green River Floodplain Connection and Levee Removal Study in 1996. The goal of the Levee Removal Study was to evaluate the system responses to levee removal and make specific recommendations concerning the value of floodplain re-connection for razorback sucker recovery (Lentsch 1996, Lentsch et al. 1996a, Birchell et al. 2002). However, because there were very few razorback sucker in the Green River, answers to several important questions pertaining to razorback sucker use of the floodplain were not answered during the initial Levee Removal Study (Birchell et al. 2002). These questions were:

1) Can larval razorback sucker be entrained in the floodplain by lowering levees to improve the river-floodplain connection?

2) Can they be entrained at high enough numbers to ensure some survival from predation by nonnative fish and piscivorous insects?

3) Will razorback sucker that survive migrate from the floodplain during high flows and recruit into the river population?

4) If so, what cues trigger migration from the floodplain? The purpose of this study was to try and answer the latter three questions. A separate scope of work was submitted and approved to answer the first question (Christopherson 2000a).

The goal of this study was to evaluate if floodplain depressions will aid in the natural recovery of razorback sucker. The specific objectives of this study were to:

1) Stock larval and juvenile razorback sucker in selected floodplain depressions.

2) Monitor Stocked fish.

A) Determine larval and juvenile razorback sucker survival rate in a nonnative dominated environment for a period of one or more years.

B) Determine growth rate of larval and juvenile razorback sucker in a nonnative dominated environment.

C) Determine if fish leave wetlands after using floodplain depressions for a period of one or more years (recruitment into the mainstem population).

D) Assuming C is true, determine how long fish use wetlands before leaving and what factors trigger movement from floodplain wetlands to the river.

STUDY AREA

This study was conducted on the Green River at The Stirrup, Baeser Bend and Above Brennan floodplain wetland depressions. These wetlands are located on the Green River about 27.0 km south of Vernal, Utah between Rm 273.0 and 268.0 (Rkm 432.0 and 444.0)(Figure 1). This section of the Green River is characterized by low gradient flow and extensive floodplain habitat. Tamarisk (*Tamarix ramosissima*) has invaded large areas of shoreline and floodplain habitats throughout this reach. Native vegetation types (willow, *Salix* spp.; Fremont cottonwood, *Populus fremontii;* and skunkbush, *Rhus trilobata*) also occupy abundant areas along shoreline and floodplain habitats.

Naturally occurring levees deposited along the river margin were breached at each wetland site during the Levee Removal Study to increase the frequency of river-floodplain connection (Birchell et al. 2002, FLO-Engineering 1997 and 1998). Breaches were cut to allow flooding at river flows of 13,000 cfs. However, sedimentation and down-cutting at breach locations altered the flows required for flooding at each site.

The Stirrup site is a located at Rm 273.0 (Rkm 444.0) and connected with the river at flows near 15,000 cfs during the study (Figures 1 and 2). The breach cut is located at the downstream end of the site and measures 146 m long by 6 m wide. For this single downstream breach configuration water rapidly enters the site through the breach during filling. After the site fills, water slowly pulses into and out of the site with each river flow fluctuation. About 7.8 ha inundate at flows of 13,000 cfs (FLO-Engineering 1997 and 1998). Slightly more area would be inundated at flows of 15,000 cfs.

Baeser Bend is located at Rm 272.6 (Rkm 439.3) and connected with the river at flows near 14,000 cfs during the study (Figures 1 and 3). The breach cut for this site is located near the middle and measures 61 m long by 6 m wide. Because this site also has a single breach, connection with the river is similar to that described for The Stirrup. About 15.5 ha inundate at 13,000 cfs (Figure 3). Slightly more area would be inundated at flows of 14,000 cfs.

Above Brennan is located at Rm 268.0 (Rkm 432.0) and connected with the river at flows near 11,000 cfs (Figures 1 and 4). Unlike Baeser Bend and The Stirrup, which have only one connection point, Above Brennan connects with the river at five points (Figure 4). One breach measuring 30.5 m long by 12 m wide was cut at the downstream end of the site in 1998. Three other breaches were cut at the upstream end of the site in 1999. There is also a natural connection near the middle of the site. Because of these upstream connections flooding is different from flooding at The Stirrup and Baeser Bend. After the initial filling stage water flows into the site at the four upstream connection channels and out at the downstream breach cut. As a result of this flow-through current, scouring occurs at the downstream breach cut and flows required for connection have decreased to approximately 11,000 cfs at the downstream breach. About 16.5 ha inundate at 13,000 cfs (Figure 4). Slightly less area inundates at flows of 11,000 cfs.

METHODS

Stocking fish

All razorback sucker used for this study were obtained from the Ouray National Fish Hatchery. Stocking densities for age-1 and larval razorback sucker were dependent on the number of excess fish available from the hatchery. Excess age-1 fish were available in the fall of 1998, spring of 1999 and spring of 2000. Larval fish were available for stocking in 1999 and 2001.

Most age-1 razorback sucker were stocked by hatchery personnel in the spring just prior to floodplain connection with the river. The only exception occurred when 125 fish were stocked in the fall of 1998 (Table 1). All fish stocked in the study sites were tagged with coded wire tags to distinguish them from other razorback sucker stocked in the river. Each of the three sites received 1,985 age-1 razorback sucker in the spring of 1999 and 2,511 in the spring of 2000 (Table 1). Based on site inundation areas at river flows of 364 m^3/s (13,000 cfs) stocking densities in 1999 were 254 fish/ha at The Stirrup, 128 fish/ha at Baeser Bend and 120 fish/ha at Above Brennan. Stocking densities in 2000 were 322 fish/ha at The Stirrup, 162 fish/ha at Baeser Bend and 152 fish/ha at Above Brennan (Table 1).

To determine if mortality occurred as a result of stocking stress, 204 age-1 fish were returned to the hatchery in 1999. These fish were transported to the study sites on the same day all age-1 fish were stocked. Instead of stocking them in the study sites they were returned to the hatchery and stocked into a pond for closer observation. No mortality occurred and these fish were stocked into Baeser Bend sixty two days later on

28 July, 1999 (Table 1).

Larval razorback sucker were received from the Ouray Hatchery by Utah Division of Wildlife personnel. Larval fish were placed in sealed plastic bags inside coolers and transported to the site. Before larval fish were released they were thermally acclimated at the site. During release the bags were cut open and fish were allowed to swim freely from the bag into the site.

All larval razorback sucker received in 1999 were stocked into The Stirrup site. during the river-floodplain connection period. Four groups of larval fish totaling 56,907 fish were stocked into The Stirrup between 18 May and 2 June 1999. The number of larvae stocked during each trip was 7806, 17568, 7183 and 25350. Based on an inundation area of 7.8 ha the stocking density for these fish was 7,296 fish/ha (Table 1).

In 2001, all larval razorback sucker were stocked in Baeser Bend. Because of lower spring flows, stocking occurred about ten days prior to river-floodplain connection in water remaining from the previous year. Baeser Bend received 58,240 total larval razorback sucker. On 8 May 2001, 25,458 larval fish were stocked and on 11 May, 32,782 fish were stocked. Based on an inundation area of 15.5 ha at 364 m^3/s the stocking density at this site was 3,757 fish/ha (Table 1).

Monitoring stocked fish

To determine survival and growth, sampling was conducted at the end of the growing season in late summer or early fall and in the following spring prior to river-floodplain connection. Fish were sampled with 6 mm mesh fyke nets with a single 0.91 m x 15.2 m lead, 0.91 m x 1.82 m rectangular frame, 5 hoops and 3 funnels. Between eleven and 21 fyke nets were used at each site during a sampling trip. Fyke nets were set in the sites and checked daily for three to five days. After fyke net sampling was concluded a “scare and snare” tactic with an electrofishing boat and trammel nets was employed. An outboard powered aluminum Jon boat equipped with a 6000 watt generator and Smith-Root Model 5.0 GPP was used for electrofishing. Between one and three trammel nets were used to snare fish. A large net measuring 1.5 m wide x 45.7 m long with 15.2 cm walling x 2.5 cm mesh was used during each effort. Additional nets when used were 1.22 m wide with three 7.6 m panels of different walling and mesh sizes. These sizes were 20.3 cm walling x 2.5 cm mesh, 17.8 cm x 1.9 cm and 15.2 cm x 1.3 cm. Electrofishing (scare) was conducted in the vicinity of the trammel net and attempts were made to herd fish into the net (snare).

During fall 1999 and spring 2000 sampling, captured razorback sucker were weighed, measured, tagged with a Passive Integrated Transponder (PIT) tag, and released back into the sites. Mark-recapture population estimates for age-1 fish stocked in 1999 were generated for each site following the first growing season.

Below average spring flows and summer drought conditions resulted in poor water quality at each study site during summer 2000. Razorback sucker were not caught at The Stirrup site during late summer sampling indicating a possible complete loss of fish in the site. With declining water quality, continued survival of razorback sucker in the Baeser Bend site became a concern. These razorback suckers were captured, weighed, measured, PIT tagged and released into the river. Fish health such as condition factor, and fin condition appeared to be better at Above Brennan than at the other sites. Razorback sucker captured in Above Brennan were weighed, measured, PIT tagged and released back into the site.

Temperature and dissolved oxygen readings were periodically recorded in the late summer and during the winter through the ice. These readings were recorded during the 1999 - 2000 winter and summer of 2000. Water quality readings were measured with a Hydrolab ® water quality monitoring instrument.

Monitoring movement to the river

To monitor razorback sucker movement from the sites, traps were set in levee breaches at each site prior to connection. There was only one levee breach to monitor at The Stirrup and Baeser Bend. However, Above Brennan had multiple breaches. The traps to capture fish were set in the downstream breach. Attempts were made to prevent fish movement from the site through the other four breach locations by setting block nets. However, this did not work well because high water flows eroded the substrate under the nets and created holes that fish could pass through.

Traps were set at all three sites in 1999 and 2000. Above Brennan was the only site sampled in 2001. During 1999, the traps were constructed from 6 mm mesh plastic netting and 2.5 cm diameter plastic tubing. They consisted of two side leads and a chamber with a single funnel (Figure 5). In 2000, these plastic mesh traps were replaced with specially designed fyke nets that were 19 mm mesh, with three 1.2 m x 1.5 m rectangular frames, three hoops and one funnel (Figure 6). The funnel opening was positioned at the bottom of the net for shallow water fishing. Both trap types were placed in lowest point of the levee breaches (parallel to the cut), with leads extending out to the right and left outer banks of the cuts. One trap was set to catch incoming fish and the other to catch outgoing fish. Traps were checked daily during the river-floodplain connection period. All captured razorback sucker were weighed, measured and PIT tagged. Fish caught in the outgoing trap were released into the river and any razorback sucker caught in the incoming trap were released into the floodplain site.

Monitoring dispersal in the river

Monitoring of dispersal of floodplain stocked razorback sucker in the Green River was done by analyzing capture and tagging data of razorback suckers captured from sampling efforts of Abundance Estimates of Colorado pikeminnow and Northern pike control in the middle Green River. This data was analyzed to determine if the razorback sucker captured was a wild fish, hatchery produced fish stocked in the river, or a hatchery produced fish stocked into a floodplain site. This analysis is based on the premise that all age-1 hatchery produced razorback suckers stocked into the floodplain were tagged with a coded wire tag and all razorback suckers stocked into the river are PIT tagged. A fish was considered probable of being stocked into a floodplain site if it did not have a PIT tag, was not scanned or scanned negative for coded wire tags, and was within the size range of positive floodplain fish.

RESULTS

Survival

At The Stirrup, five days of sampling with fyke nets and one day of electrofishing resulted in the capture, PIT tagging, and release back into the site of 101 razorback sucker. Following this initial tagging effort one day of “scare and snare” sampling resulted in the capture of 31 razorback sucker with four recaptures. Based on these captures, the razorback sucker population in The Stirrup was estimated at 783 fish or 37% survival after the first growing season (95% confidence interval ± 730) (Figure 7). There were a total of 128 individual razorback sucker tagged during fall sampling. Fyke net and scare and snare sampling in the spring resulted in the capture of 74 fish with 8 recaptures.

At Baeser Bend 761 individual razorback sucker were PIT tagged or marked in three days of sampling with fyke nets. One day each of sampling with fyke nets and electrofishing following the initial tagging effort resulted in the capture of 109 razorback sucker with 73 recaptures. Based on these captures the razorback sucker population estimate in Baeser Bend was estimated at 1,136 fish or 52% survival after the first growing season (95% confidence interval ± 152) (Figure 7). There were a total of 797 individual razorback sucker tagged during fall sampling. Fyke net and scare and snare sampling in the spring resulted in the capture of 121 fish with 74 recaptures.

At Above Brennan 129 individual razorback sucker were PIT tagged in 3 days of sampling with fyke nets in the fall. One day of “scare and snare” sampling following the initial tagging effort resulted in the capture of 35 razorback sucker with 4 recaptures.

Based on these captures the razorback sucker population in Above Brennan was estimated at 1,129 fish or 57% survival after the first growing season (95% confidence interval ± 1,062) (Figure 7). There were a total of 160 individual razorback sucker tagged during fall sampling. Fyke net and scare and snare sampling in the spring sampling resulted in the capture of 63 fish with seven recaptures.

Razorback sucker survival was significantly reduced in 2000 which coincided with below average spring flows, and drought conditions that persisted through the summer. Water quality in the study sites became a concern in early August 2000, when water depths approached levels normally observed entering winter months. On 15 August, numerous dead carp were observed at The Stirrup site. However, razorback sucker carcasses were not observed. Razorback sucker were not captured during sampling immediately following observation of the fish kill. Weekly visits to the site were made beginning in mid July of 2000 and dead razorback sucker were never observed. Mortality of razorback sucker in The Stirrup site probably occurred between 4 June (date of disconnection) and the July visits. This was likely a result of an oxygen deficit from high biochemical oxygen demand of decomposing organic matter.

At Baeser Bend a fish kill occurred over the weekend of 12 - 13 August 2000. Dead razorback sucker were not observed at the site on 11 August. On Monday August 14, several hundred dead razorback sucker were observed along the shoreline at the site. Trammel net sampling resulted in the capture of several razorback sucker, indicating some survival.

Just prior to both observed fish kills water quality concerns resulted in the decision to pump water into the sites. Pumping was scheduled to begin during the week of 14 August 2000. Pumping was initiated at Baeser Bend on 15 August. Although water conditions in Above Brennan never resulted in a fish kill, water was pumped into the site as a precautionary measure beginning on 18 August 2000. Pumps at both sites were run periodically until 22 September 2000. During this period about 25 cm (10 inches) of water depth was added to each site. This added water depth only lasted for about one week.

Water quality conditions in Baeser Bend remained poor and the decision was made to mechanically remove most surviving razorback sucker and transport them to the river. This effort resulted in the capture of 520 razorback sucker. Six fish died during handling, resulting in the release of 514 razorback sucker to the river. Using the removal method (depletion curve) for estimating population numbers, there were an estimated 749 razorback sucker in the site (95% confidence interval ± 320) (Figure 8). Subtracting 520 from 749, there were still an estimated 229 razorback sucker that remained entering the winter. Razorback suckers were not caught in the site the following spring and carp were the only fish species collected. Dead carp on the shoreline at ice out was evidence of winter kill. Therefore, it is believed none of the razorback sucker remaining in the fall survived the winter.

Late summer fish kills were not observed at Above Brennan in 2000, indicating water quality conditions were better than in The Stirrup and Baeser Bend. However, as a precaution water was also pumped into Above Brennan beginning on 18 August. Sampling in early September 2000, resulted in the capture of 32 razorback sucker with 6 recaptures. All of these captures were from the group stocked in 1999. These razorback sucker visually appeared healthier and averaged 149 grams heavier than those from the same age class captured in Baeser Bend. Because of their healthy appearance, razorback sucker captured in Above Brennan were released back into the site to overwinter. Sampling the following spring resulted in the capture of 48 razorback sucker with 14 recaptures. Because the closed population assumption was violated by a connection with the river, population estimates were not generated from either fall 2000 sampling or spring 2001 sampling. Above Brennan was sampled for the final time late in the summer 2001 and no razorback sucker were caught. Presumably razorback sucker that remained in the site following spring 2001 sampling left the site for the river during connection or died later in the summer.

Razorback suckers from the cohort stocked into Above Brennan in the spring of 2000 were never captured. The exact cause of their disappearance is unknown. However, dead razorback sucker from this age class were observed floating against the leads of breach traps during connection. This suggests some if not all may have died shortly after stocking. Although there is no evidence supporting it, another possibility is they left the site during connection.

Larval razorback sucker were stocked into The Stirrup site in 1999 and into Baeser Bend in 2001 (Table 1). Survival of larval razorback sucker was never detected during the study.

Growth

Growth rates of age-1 razorback sucker stocked in 1999 were identical in The Stirrup and Above Brennan sites for the first growing season. Growth rates of razorback sucker averaged 1.3 mm/day and 2.1 to 2.2 grams/day, respectively (Figures 9 and 10). In The Stirrup, razorback sucker grew from an average length of 110 mm at stocking to 317 mm in September (Figure 11). Weight gains averaged 336 grams (12.8 g at stocking to 348 g). Razorback sucker in Above Brennan grew from an average length of 96 mm at stocking to 310 mm in October (Figure 12). Weight gains averaged 347 grams (12.8 g at stocking to 360 g).

Length frequencies and average fish size in The Stirrup and Above Brennan sites for April 2000 sampling were similar to fall 1999 sampling (Figures 11 and 12). Spring 2000 was last time razorback sucker were caught in The Stirrup site during the study. In Above Brennan growth monitoring of razorback sucker from the age class stocked in 1999 continued through the spring of 2001. Their average size following the second growing season (fall 2000) was 410 mm and 863 grams (Figure 13). Average growth rates for the second growing season were 0.5 mm/day and 2.6 grams/day (Figure 14). In spring 2001, average fish size was similar to fall 2000 average size at 412 mm and 932 grams (Figure 13).

At Baeser Bend it is important to distinguish between both groups of age-1 razorback sucker that were stocked in 1999 (Table 1). The first group was stocked in April and numbered 1,985 fish. A second group of 204 fish were stocked in July (Table 1). These were the fish returned and raised at the hatchery to monitor mortality from stocking stress. Fish stocked in July had their right pelvic fin clipped to distinguish them from fish stocked in April. Growth monitoring for both groups of fish continued until the summer of 2000.

Average growth rates of razorback sucker stocked in April 1999 were slightly higher in Baeser Bend than in The Stirrup and Above Brennan. In Baeser Bend, razorback sucker grew from an average length of 111 mm at stocking to 341 mm in

September (Figure 15). Weight gains averaged 442 grams (15.5 g at stocking to 457 g) or about 100 grams more than weight gains in The Stirrup and Above Brennan. Growth rates for razorbacks stocked in April averaged 1.4 mm/day and 2.7 grams/day (Figure 16).

Razorback sucker that were stocked in July grew at the Ouray National Fish Hatchery from an average length of 115 mm in April to 180 mm in July (Ouray National Fish Hatchery 1999). In September, their average length was 286 mm (Figure 15). Fish stocked in July averaged 46 grams of weight gain (15.5 in April to 61 grams in July) at the hatchery and 224 grams in Baeser Bend (61g 28 July to 285 g September). Growth rates for these fish while at the hatchery were 0.8 mm/day and 0.3 grams/day compared to 1.5 mm/day and 1.4 grams/day after being stocked into Baeser Bend (Figure 16).

In spring 2000, razorback sucker that were stocked in April 1999 into Baeser Bend averaged 353 mm and 526 grams and those stocked in July averaged 294 mm and 341 grams (Figure 17). Following the second growing season (late summer 2000) April stocked fish averaged 409 mm and 722 grams (Figure 17). July stocked fish were similar at 391 mm and 661 grams. Average growth rates for the second growing season were 0.3 mm/day and 1.2 grams/day (Figure 18).

Baeser Bend is the only site where age-1 fish that were stocked in April 2000 survived. These fish averaged 103 mm at the time of stocking and grew to 282 mm by August (Figure 17). Weight gains averaged 231 grams (12.8 g at stocking to 244 g). Average growth rates these fish were similar to growth rates for fish stocked in 1999. Fish stocked in 2000 averaged 1.4 mm/day and 1.8 grams/day compared to 1.4

mm/day and 2.7 grams/day in 1999 (Figures 19 and 16).

Monitoring movement to the river

The first river-floodplain connection period following the April 1999 stocking occurred between 12 May and 25 June 1999. Connections in 1999 were maintained for 52 days at Above Brennan, 33 at Baeser Bend and 31 at The Stirrup. During this connection period following the April 1999 stocking only two razorback sucker were caught in traps set to catch fish leaving the sites (Table 2). Both of these fish were caught at Baeser Bend on the same day. These few captures, combined with previously discussed survival estimates, indicate most razorbacks stocked in 1999 remained in the sites.

In 2000, the river-floodplain connection period occurred between 24 May and 7 June. Because of below average spring flows connection durations in 2000 were considerably shorter than 1999 durations. Connection durations were 15 days at Above Brennan, seven days at Baeser Bend and only three days at The Stirrup. Low spring flows also resulted in shallow water depths at connection points, particularly at The Stirrup and Baeser Bend (Figure 6). Water depth during connection was only 5 cm (2 inches) at The Stirrup and about 30 cm (12 inches) at Baeser Bend. During this connection period, 31 age-2 razorback sucker were caught in outgoing traps at Baeser Bend, ten at Above Brennan and one at The Stirrup (Table 2).

Above Brennan was the only site where breach traps were set in 2001 and no razorback sucker were captured leaving the site. However, traps were only placed in the downstream breach. Therefore, undetected movement from the site could have easily been accomplished through any of the upstream breaches.

Monitoring dispersal in the river

Razorback sucker that were originally stocked in the study sites in 1999 were caught in the Green River during sampling efforts for other projects in 2000 and 2001 (Appendix A, Tables 5 - 7). Most of the fish caught while sampling in the river had not been caught in breach traps. This suggests the breach traps were not effective at monitoring movement out of the floodplain site. During abundance estimate sampling for Colorado pikeminnow (Hawkins 1999) in 2000, 41 individual razorback sucker were captured (Table 2 and Appendix A, Table 5). Nineteen of these razorback sucker were positively identified as fish originally stocked in the study sites and four more were probable (Table 2 and Appendix A, Table 5). These 23 fish comprise 56% of the razorback sucker caught in the Green River in 2000 (Table 2). Three of the 23 razorbacks were caught in breach traps during connection and three others were previously PIT tagged during in situ sampling (Table 3). Four fish were originally PIT tagged in Baeser Bend and two in Above Brennan. Three of the fish were caught in the Duchesne River near the Green River confluence. The other three were caught in the Green River at river miles 300.0 (Rkm 484.0)1 Rm upstream from Ashley Creek, 259.4 (Rkm 403.5)1 Rm upstream from Old Charley Wash and 277.8 (Rkm 447.0) 2 Rm from The Stirrup site (Table 3 and Figure 1). The average distance a fish traveled from the point of origin was 20.3 Rm (32.7 Rkm) (Table 3).

During abundance estimate sampling for Colorado pikeminnow (Hawkins 1999) and northern pike removal in 2001 (Christopherson 2000b), 148 individual razorback sucker were caught in the Green River (Table 2 and Appendix A, Table 6). Seventy-one of these razorbacks were positively identified as fish originally stocked in the floodplain and twenty more were probable (Table 2 and Appendix A, Table 6). These fish comprise 61% of the razorback sucker caught in the river during 2001 (Table 2). Three of these ninety one razorbacks caught in the river, had been previously caught in breach traps leaving sites during connection and fourteen others were previously PIT tagged during in situ sampling (Table 4). Nine fish were originally tagged at Above Brennan, seven at Baeser Bend and one at The Stirrup (Table 4). Four of the fish were caught in the Duchesne River near the Green River confluence. Four were caught by USFWS personnel in the Green River at Moon Bottom (228.8 Rm, 368.1 Rkm), Peter's Point (192.6 Rm, 310 Rkm), Near Wildhorse Rapid (188.2 Rm, 368.1 Rkm) and just below Swaseys Rapid (128.5 Rm, 206.9 Rkm). These four fish traveled an average of 86.4 m from the Above Brennan site. The remaining fish were caught in the Green River at Rm 309.5 - 311.0 (Rkm 498.0 - 500.4)near razorback bar, Rm 298.6 (Rkm 480.6) near Ashley Creek, Rm 291.4 (Rkm 468.9) 1.4 m upstream from Bonanza Bridge, Rm 274.5 - 275.0 (Rkm 441.7 - 442.5) near The Stirrup, Rm 261.4 (Rkm 420.6) near Johnson Bottom and Rm 159.6 (Rkm 256.8)near Wyasket Bottom inlet (Table 4 and Figure 1). The average distance these fish traveled from the point of origin was 21.5 m (34.6 Rkm) (Table 4).

The best estimate for the total number of razorback sucker added to the river population from this study is between one and two thousand fish (Appendix A, Table 8). There were 666 total razorback sucker definitely added to the river population from floodplain habitat. Forty-four razorbacks were caught leaving the study sites, 108 left the sites but were caught later in the river (Table 2), and 514 razorbacks were captured using trammel nets and moved to the river from Baeser Bend.

DISCUSSION

Stocked fish total length increased 300% during the first growing season (Figures 9 - 12 and 15 - 16). As expected, growth in length slowed during the second growing season. However, weight gains continued at nearly the same rate throughout the study (Figures 14 and 18). Growth data collected during this study was consistent with other studies and supports the premise that floodplain wetland habitats are important for young razorback sucker. Fish grew rapidly in the highly productive floodplain wetlands, and presumably survival was enhanced as a result of the larger young fish becoming less susceptible to predation (Wydoski and Wick 1998, Lentsch 1996, and Osmundson and Kaeding 1989).

Population estimates indicate age-1 razorback sucker stocked in 1999 demonstrated good survival in each site during the first year of the study. Estimates were calculated in the fall 1999. First year survival estimates with the narrowest confidence intervals were obtained for Baeser Bend. Razorback sucker survival at Baeser Bend was estimated at 52% ± 7% for fall 1999. Survival estimates at The Stirrup and Above Brennan were similar to estimates at Baeser Bend, however, confidence intervals were much wider. Survival estimates were 37% ± 35% in the fall 1999. At Above Brennan survival estimates were 56% ± 53% in the fall 1999 (Figure 7). Better survival estimates were obtained for Baeser Bend because sampling was more efficient at Baeser Bend than the other two sites. Large areas of thick dead terrestrial vegetation at The Stirrup and Above Brennan reduced sampling efficiency. In contrast Baeser Bend is more open and had very little dead terrestrial vegetation to hinder sampling.

Survival estimates and growth rates were impressive when predation by, and competition with, the large number of nonnative fish were considered. Each study site was occupied by high numbers of nonnative fish in the spring at the time of stocking. Several years of above average flow preceding the study provided conditions that allowed non-native fish populations to build up in each site (Birchell et al. 2002). During razorback sucker sampling in the fall, nonnative fish were removed from the sites and estimates were calculated using catch effort decline. There were an estimated 5357.4 kg (458,474 fish) of nonnative fish in Baeser Bend, 2708.2 kg (310,565 fish) in The Stirrup and 711.4 kg (86,122 fish) in Above Brennan (Birchell et.al 2002). These results indicate age-1 razorback sucker are very capable of competing with and avoiding predation by large numbers of nonnative fish.

Razorback sucker survival was dramatically reduced during the second year of the study. Below average spring flows and summer drought created water conditions in The Stirrup and Baeser Bend that were lethal for all fish species. At The Stirrup, low spring flows resulted in a brief connection duration that did not sufficiently fill the site. As a result, stagnant water remaining from the previous year was not adequately freshened and nighttime dissolved oxygen levels became lethal for razorback sucker sometime in the early summer (4 June - 13 July).

Unlike The Stirrup, Baeser Bend and Above Brennan filled during river-floodplain connection in all years. Late summer water depths were nearly the same in each site, however, an estimated 50 - 75% of the razorback sucker in Baeser Bend were lost. Late summer fish kills were not observed at Above Brennan. Differences in connection configurations between the two sites may explain why fish kills occurred at Baeser Bend and not at Above Brennan. Baeser Bend is configured with a single connection point near the middle of the site. Water in Baeser Bend must enter and leave the site through the same breech. As a result, the complete flushing of remnant water from the previous year does not occur. In contrast, Above Brennan is configured with upstream and downstream breech connections allowing water to flow-through the site for a more complete freshening replacement of the water.

Concerns about water quality prompted efforts to augment water at each site late in the summer 2000. Water augmentation was expected to improve water quality and prevent the sites from drying out. During the weekend just prior to the scheduled starting date for pumping the fish kill at Baeser Bend occurred. The opportunity to perhaps have prevented the fish kill was missed by just a few days. Because the fish kill was partial, pumping was still initiated at Baeser Bend on 15 August 2000. Water augmentation at Baeser Bend did not prevent the estimated 229 remaining razorback sucker from dying during the winter. Razorback sucker in Above Brennan did survive through the winter.

Survival of larval razorback sucker was not detected during the study. This could either be the result of ineffective sampling methods or that measurable survival of larval razorback sucker did not occur. Although sampling ineffectiveness cannot be completely eliminated as a possibility, it is unlikely given that both sites were sampled intensively for several days.

If stocked larval razorback sucker did not survive during this study, what caused their mortality? Two possible explanations for larval razorback sucker mortality that have been examined in the Lower Colorado River Basin at Lake Mohave are food limitation and predation (Horn et.al 1994, Peepuls and Mickey 1992, 1990, and Marsh and Langhorst 1988). Poor water quality, insufficient stocking densities to overcome predation and stress from stocking are additional possibilities suggested for this study.

Limited food supply is unlikely to reduce larval survival in floodplain wetlands because zooplankton densities are typically higher in floodplain wetland habitats than main channel and backwater habitats (Birchell et.al 2002, Wydoski and Wick 1998, and Cooper and Severn 1994). However, zooplankton data were not collected, therefore, no definitive evidence exists suggesting adequate quantities and proper sized zooplankton were available for consumption by larval razorback sucker at the time of stocking.

Predation is a more plausible explanation for larval razorback sucker mortality during this study. Johnson et al. (1993) determined larval razorback sucker were predator naive and were not likely to survive with high numbers of nonnative fish. Although nonnative fish densities for each site at the time of stocking must be estimated, densities were likely much higher at The Stirrup than at Baeser Bend. Four months after stocking larval razorback sucker there were an estimated 2708.2 kg (3 tons) or 310,600 nonnative fish in The Stirrup (Birchell et al. 2002). Species composition consisted of 53.2% fathead minnow, 35.6% black bullhead, 6% green sunfish, 3.8% red shiner and 1.3% carp. Nonnative fish densities were lower at Baeser Bend because a significant portion of the nonnative fish population perished during the summer of 2000. In addition to nonnative fish, odonate nymphs are present in the study sites and may also prey on larval razorback sucker. Under laboratory conditions odonate nymphs were capable of destroying significant numbers of larval razorback sucker (Horn et al. 1994). Predation by odonate nymphs may have explained larval razorback sucker survival failure in fishless backwaters at Lake Mohave (Horn et al. 1994).

Could predation be overcome if larval razorback sucker were stocked at higher densities? Nearly the same total number of larval razorbacks were stocked into the two sites (56,907 and 58,240) (Table 1). These numbers are only slightly above the average fecundity of a single female razorback sucker (46,740 eggs/female) reported by McAda (1977). Another factor related to stocking density is that not all larval fish were stocked on the same day. At The Stirrup fish became available for stocking four different times between 18 May and 1 June 1999. Similarly, in 2001 larval fish were received in two groups for stocking into Baeser Bend. Stocking larval razorback sucker at higher densities than those of this study, and on the same day may help overcome predation.

Water quality is not a likely cause of mortality for larval fish stocked into The Stirrup because stocking occurred during connection with the river. However, at Baeser Bend in 2001, water quality may have been an issue. Because of below average flows floodplain connection with the river was delayed until 18 May. Larval razorback sucker were available for stocking on 8 and 11 May (Table 1). As a result larval razorbacks were stocked prior to freshening water in the site from the river. Water quality concerns are speculative because water quality readings were not recorded when fish were stocked.

Stocking stress is another potential cause of mortality. However, there are no data indicating mortality occurred as result of activities associated with stocking. In both stocking instances larval fish were thermally acclimated prior to release into the sites. Upon release larval fish appeared healthy and were actively dispersing from the release point.

The effectiveness of nets set to monitor movement of fish from the sites was hindered by high water velocities during filling, and by beaver and muskrats chewing holes in the nets. Problems with high water velocity primarily occurred in 1999. During the week long wetland filling stage, high velocity flows eroded soil underneath trap leads and reduced block effectiveness. Eroded areas were filled with sandbags as quickly as they were discovered. Beaver and muskrats constantly chewed holes in the traps each year of the study. These holes created opportunities for fish to escape before the nets could be checked.

Although nets set to monitor fish movement into and out of the sites were not entirely effective, some knowledge of razorback sucker movement from the sites was gained. Only two age-1 razorback sucker were caught leaving the sites during the year of their stocking, indicating a preference to remain in the floodplain. Population estimate data confirms most age-1 razorback sucker remained in the sites during the first summer (Figure 7). Significantly more fish movement from the floodplain occurred one year from stocking (Table 2). Prior to the study water inflow and sexual maturity were considered possible cues that would trigger razorback sucker movement from the floodplain. Evidence from this study indicates that some fish may cue on freshwater flow into the sites during connection. Movement cued by sexual maturity could not be tested because below average flows prevented survival to sexual maturity.

Flow magnitude and connection duration probably inhibited razorback sucker movement from at least two sites. A shallow (5 cm) river connection at The Stirrup only lasted three days (Figure 6). Similarly a shallow connection lasted only seven days at Baeser Bend. Fifteen days of connection at Above Brennan provided the best opportunity for razorback sucker to leave. However, very little movement was detected at this site. All attempts to block fish movement through upstream connections failed. Most floodplain razorback sucker captured in the river probably originated from Above Brennan.

It is apparent from this study that stocking age-1 razorback sucker into floodplain depressions can potentially contribute healthy fish to the river population, thus aiding razorback sucker recovery. Success of floodplain stocking is dependent on spring river flows. A string of above average flow years is critical for naturally maintaining a floodplain environment that supports fish life through the year. The potential for mechanically maintaining these habitats, at least for short periods of time, was demonstrated.

Floodplain wetlands can be used to supplement limited razorback sucker grow-out space. Razorback sucker stocked into floodplain habitat are conditioned to cope with the river environment and learn to use natural food sources, and so may provide a higher return than fish raised to the same size in hatcheries. Predator naivety may also be reduced because fish inhabit an environment with nonnative fish. These conditioning factors may enhance survival and increase overall performance in the river environment. The validity of these ideas will be repeatedly tested through time by the performance of floodplain razorback sucker resulting from this and future studies in the river.

Despite the success of stocked age-1 razorback sucker, a critical function of floodplain wetland habitat is to provide rearing habitat for larval razorback sucker that are entrained during spring high flows. This study failed to demonstrate larval razorback sucker survival in floodplain wetland habitats. Efforts to determine if larval razorback sucker can survive in floodplain wetland habitat should continue. It is not likely nonnative fish will be eliminated from the Green River system so wild larval survival will have to occur in the presence of nonnatives. The best opportunity for wild larval razorback sucker survival in floodplain wetlands may be when a low water year eliminates nonnative floodplain fish populations and is followed by an above average flow year. During the above average flow year larval razorback sucker production will need to be high to ensure adequate numbers are entrained in the floodplain. Because nonnative fish densities are low in floodplain wetlands during the first connection following below average flow years, predation on and competition with razorback sucker should be reduced. Determining conditions that allow survival of larval razorback sucker in floodplain wetland habitats may be essential for creating self-sustaining populations that will lead to the recovery of this species in the Middle Green River.

CONCLUSIONS

1) Growth of age-1 razorback sucker stocked into floodplain sites was very good. Stocked fish grew from an average of 106mm at time of stocking to an average length of 323mm by the end of the first growing season. Rapid weight gains were also observed.

2) Growth rates for age-1 razorback sucker at the Ouray hatchery were only 50% of growth rates in floodplain habitats. (0.8mm/day at Ouray hatchery and 1.5mm/day in Baeser Bend)

3) Despite high nonnative fish densities in the study sites stocked age-1 razorback sucker survived at rates ranging from 56 to 73 percent during the first year.

4) Survival was dramatically reduced during the second year of the study as a result of below average flows that resulted in poor connection with the river and the resulting poor water quality. Long duration and high magnitude flows are important for maintaining water quality that supports fish in floodplain sites. Some mechanical support of sites can be provided.

5) Relatively intensive sampling efforts did not detect survival of larval razorback sucker during the study.

6) The exact cause of larval razorback sucker mortality is unknown. Some possibilities include; insufficient stocking densities to overcome predation, poor water quality, and failure to use available food resources.

7) Very little razorback sucker movement from the sites was detected during the first connection period. Most age-1 razorback sucker remained in the study sites for at least one year.

8) After razorback sucker were in the study sites for one year some movement of age-2 fish from the sites was observed.

9) Movement cued by sexual maturity could not be tested because below average flows were inadequate to maintain water quality and prevented survival to sexual maturity.

10) The shallow, short duration connections that occurred during 2000 may have discouraged razorback sucker movement from The Stirrup and Baeser Bend.

RECOMMENDATIONS

1) Continue studies to quantify larval razorback sucker survival to recruitment in floodplain sites. Efforts should focus on increasing larval fish entrainment in the floodplain, testing survival following a reset of nonnative fish populations, determining larval densities necessary to survive predation, options for nonnative predator control, and determining if other sources of mortality such as water quality and food availability can be managed. Entrainment and survival of larval razorback sucker in floodplain habitats represent critical links in self-sustaining razorback sucker populations.
2) Monitor the contributions to the spawning population of floodplain raised razorback sucker in the river.
3) Use floodplain depressions for razorback sucker grow-out ponds during years when average or above average flows are predicted.
4) Perform additional water quality monitoring at stocking sites.

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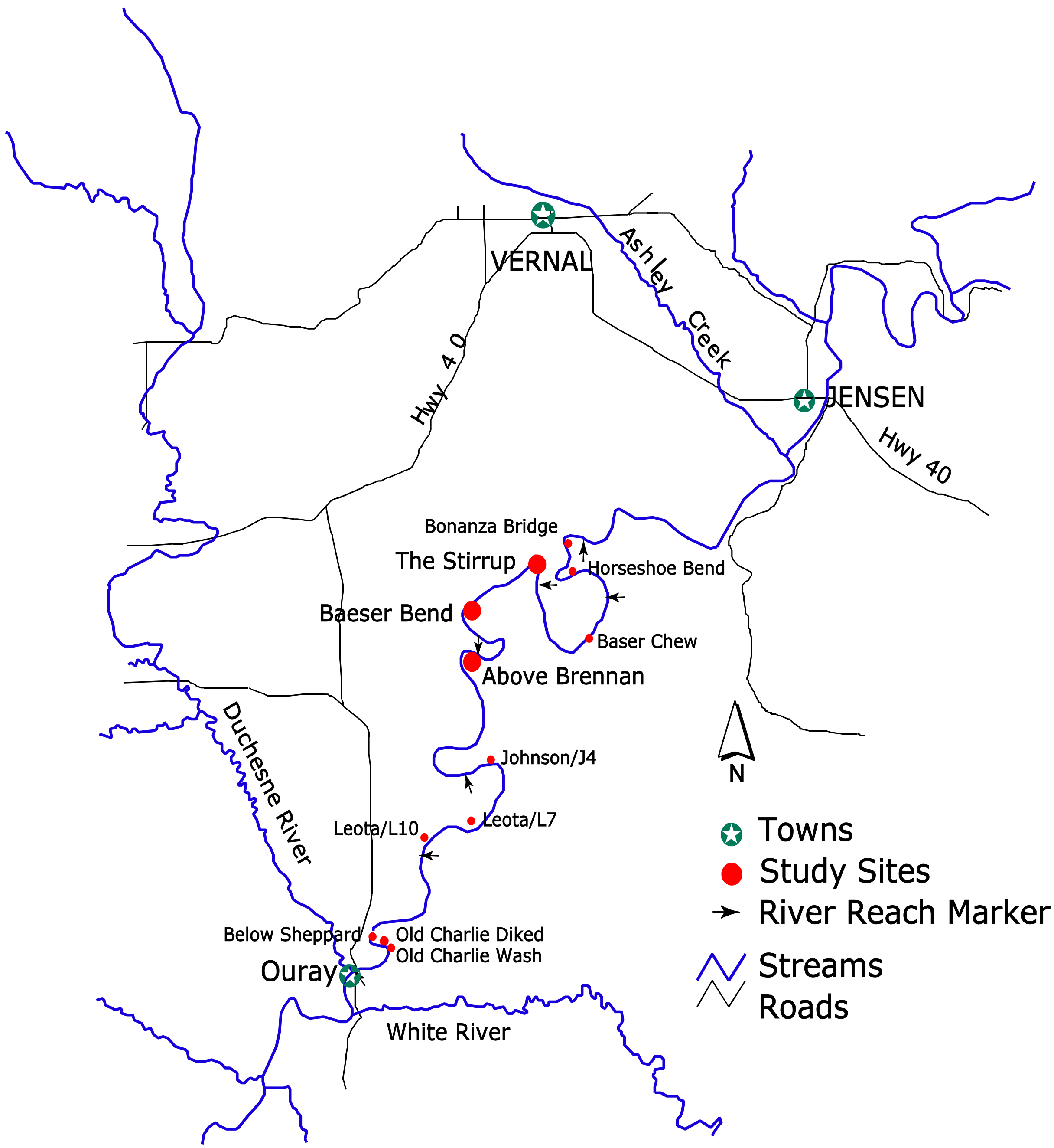


Figure 1. Map of the Middle Green River, Utah depicting the location of The Stirrup, Baeser Bend and Above Brennan study sites for razorback sucker stocking.

Figure 2. The Stirrup floodplain depression site Green River, Utah 10/98 (Rm 275.8) with approximate location of breech cut (e.g., facing south).

Figure 3. Baeser Bend floodplain depression site Green River, Utah 10/99 (Rm 272.6) (e.g., facing north).

Figure 4.
Above Brennan floodplain depression site Green River, Utah 6/98 (Rm 268.0) with approximate location of four connection points (e.g. facing South).

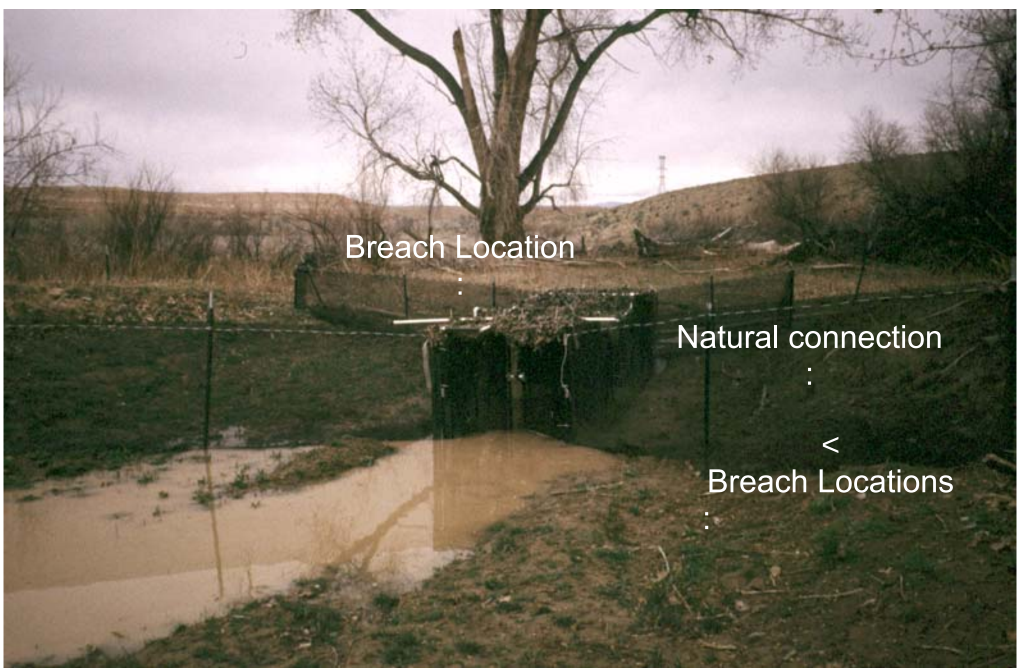


Figure 5. Breach trap at the downstream breach at Above Brennan just prior to connection with the Green River 4/99 (Rm 268.0, Rkm 432.0).

Figure 6. Breach trap at The Stirrup on 6 June, 2000 during peak flow (Rm 275.8.0) (note the shallow water depth).

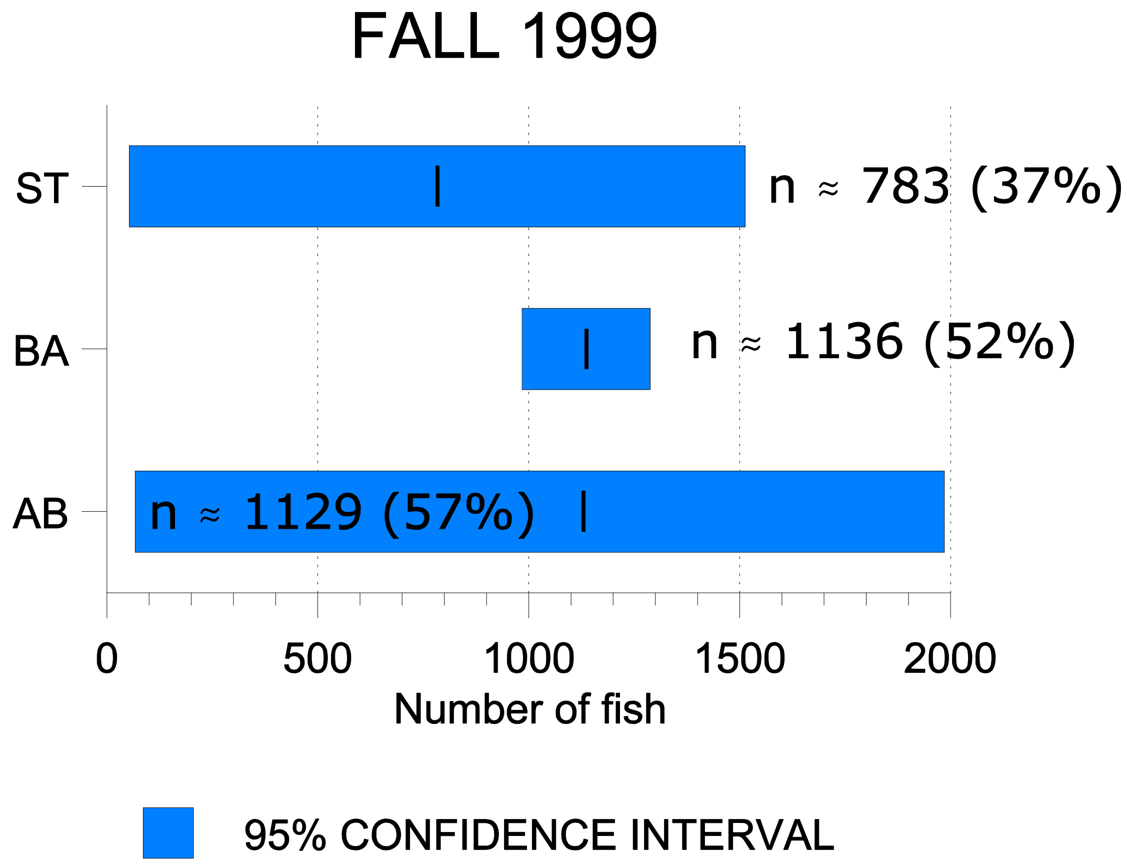


Figure 7. Population estimates with 95% confidence intervals and estimated percent survival for age-1 razorback sucker stocked into Green River, Utah floodplain depression sites during April 1999, after one growing season. Codes: ST = The Stirrup, BA = Baeser Bend and AB = Above Brennan.

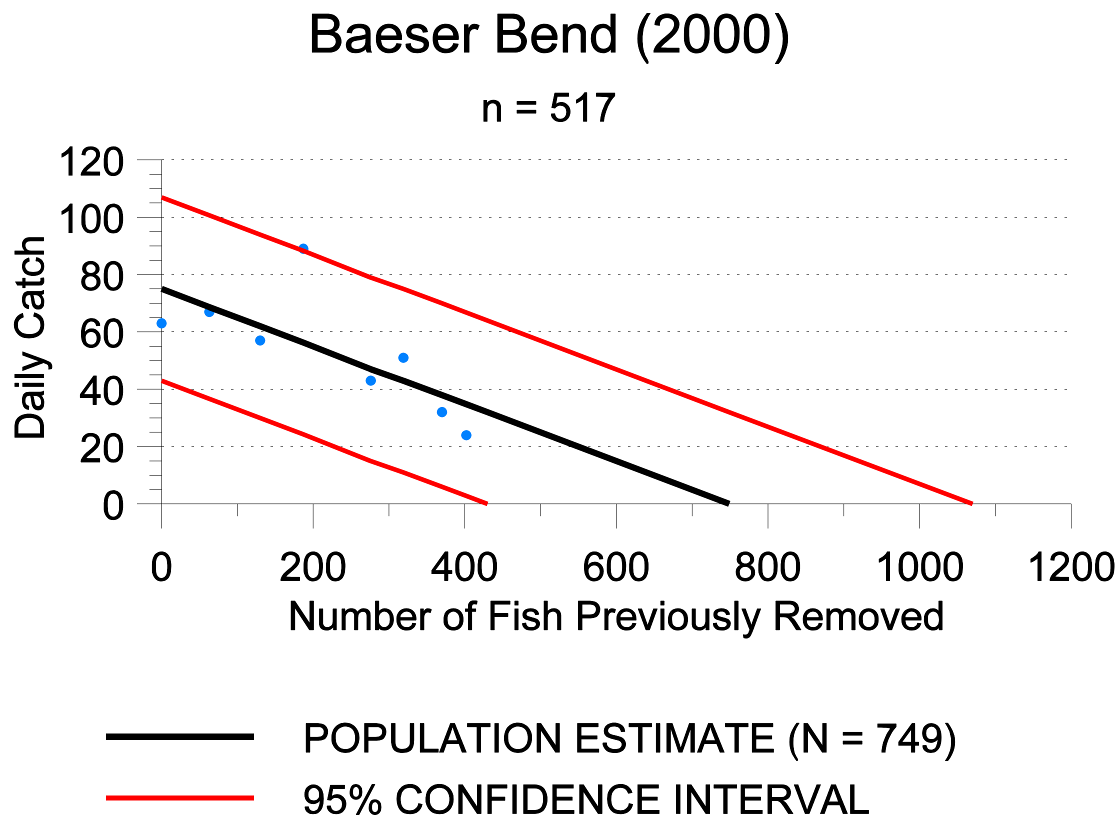


Figure 8. Population estimate with 95% confidence interval for razorback sucker remaining in the Baeser Bend floodplain depression, Green River, Utah during late summer of 2000 (Note: includes fish from both 1999 and 2000 spring stockings).

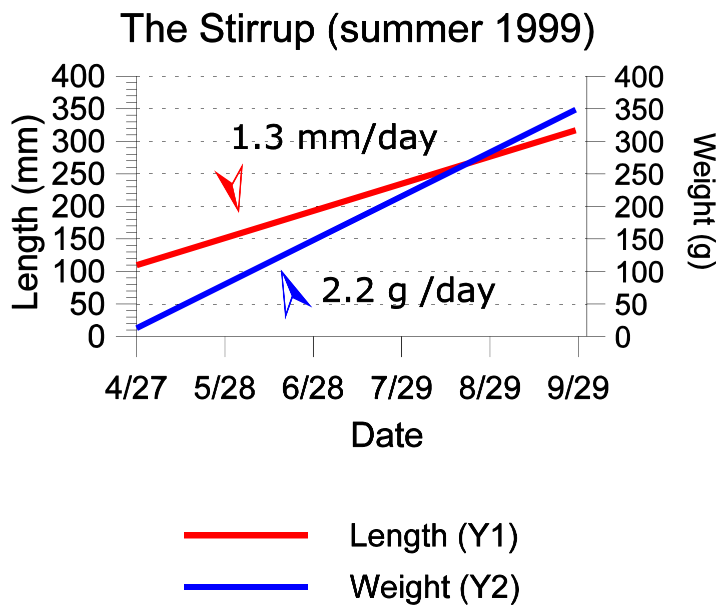


Figure 9. Linear depiction of average length and weight growth rates for razorback sucker during their first growing season in The Stirrup floodplain depression, Green River, Utah.

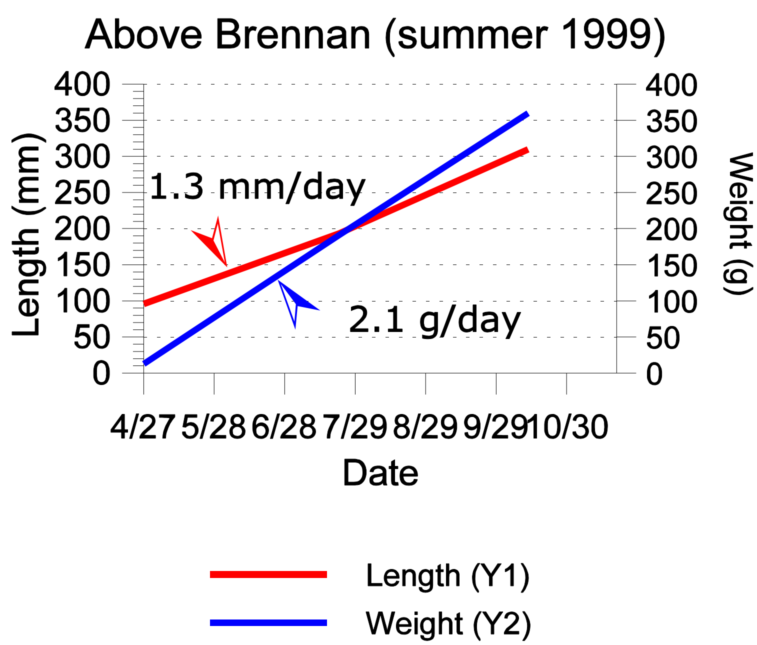


Figure 10. Linear depiction of average length and weight growth rates for razorback sucker during their first growing season in the Above Brennan floodplain depression, Green River Utah.

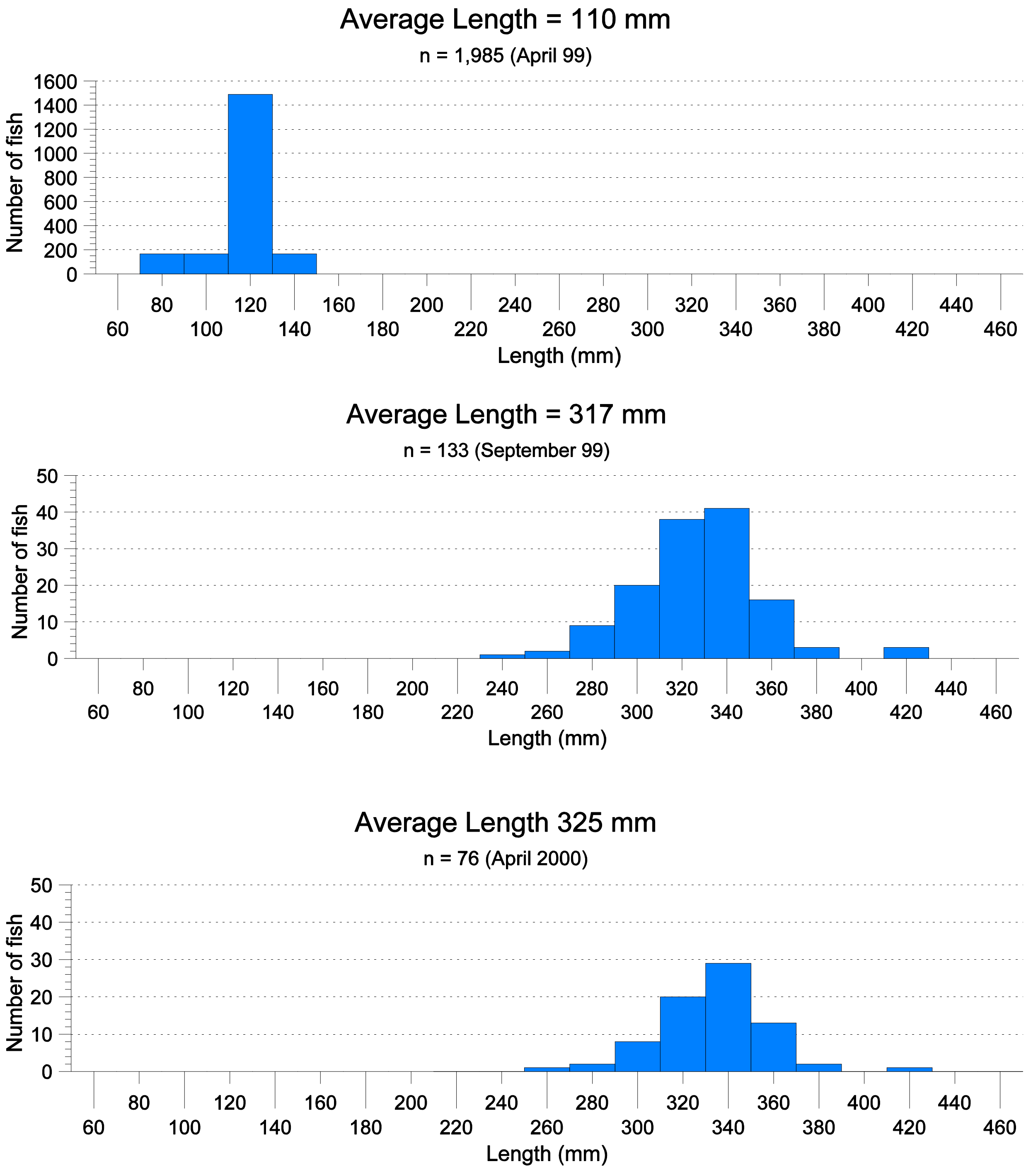


Figure 11. Length frequency at three time intervals for razorback sucker stocked during April 1999 into The Stirrup floodplain depression Green River, Utah (Note: life stages top to bottom; time of stocking, end of first growing season and after one year).

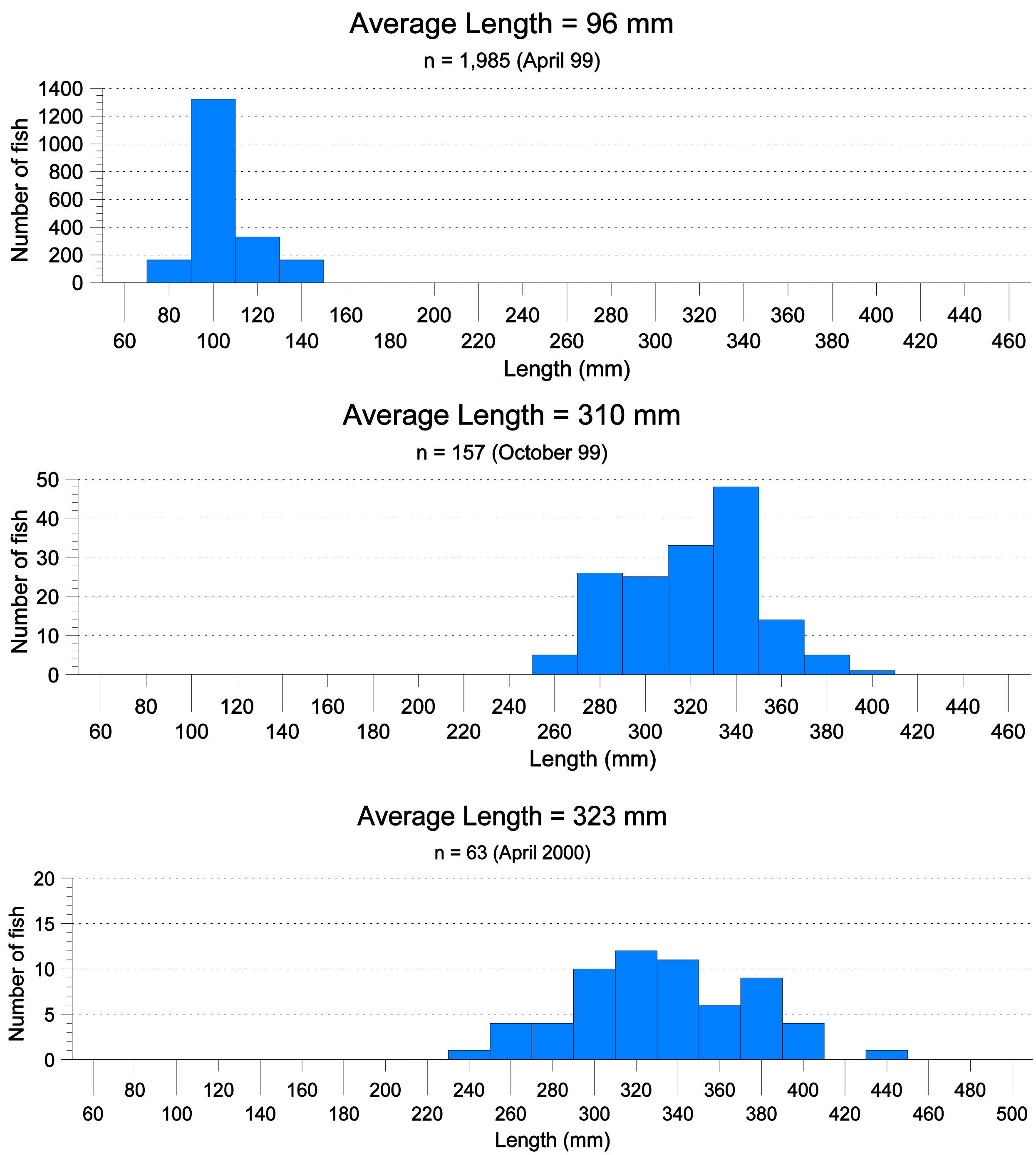


Figure 12. Length frequency at three time intervals for razorback sucker stocked during April 1999 into the Above Brennan floodplain depression, Green River, Utah (Note: life stages top to bottom; at the time of stocking, end of first growing season and after one year).

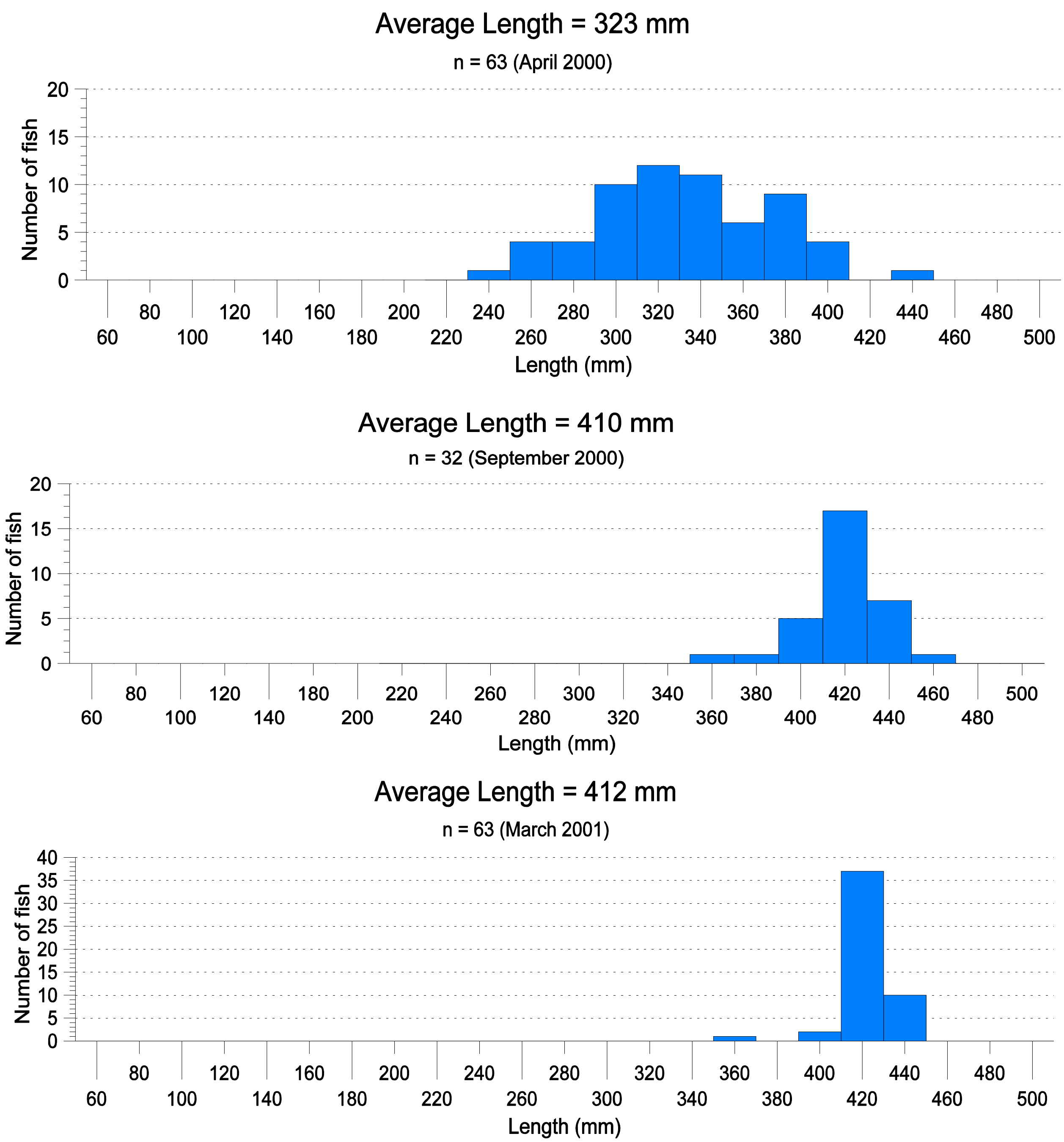


Figure 13. Length frequency at three time intervals during the second year from stocking for razorback sucker stocked into the Above Brennan floodplain depression Green River, Utah during 1999 (Note: life stages top to bottom; after one year, end of second growing season and after two years.

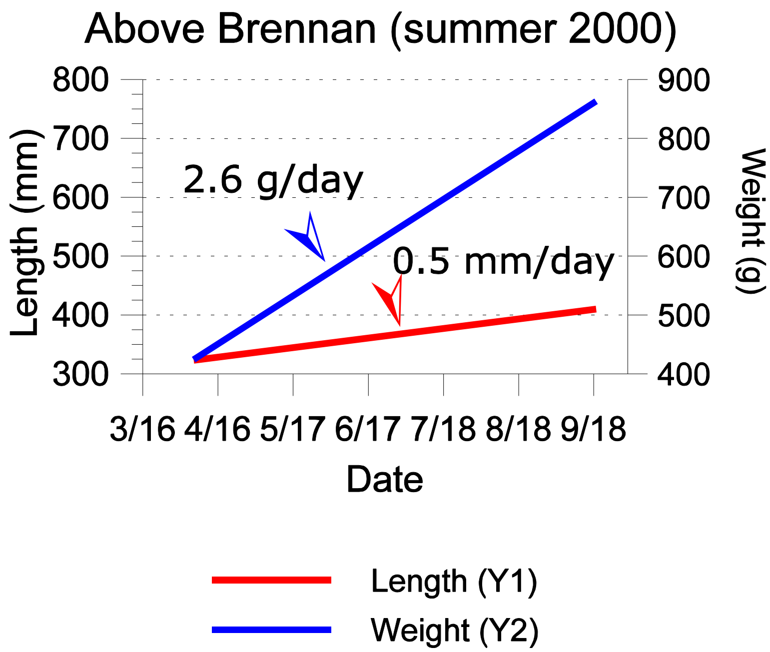


Figure 14. Linear depiction of average length and weight growth rates for razorback sucker stocked in 1999 during their second growing season in the Above Brennan floodplain depression, Green River, Utah.

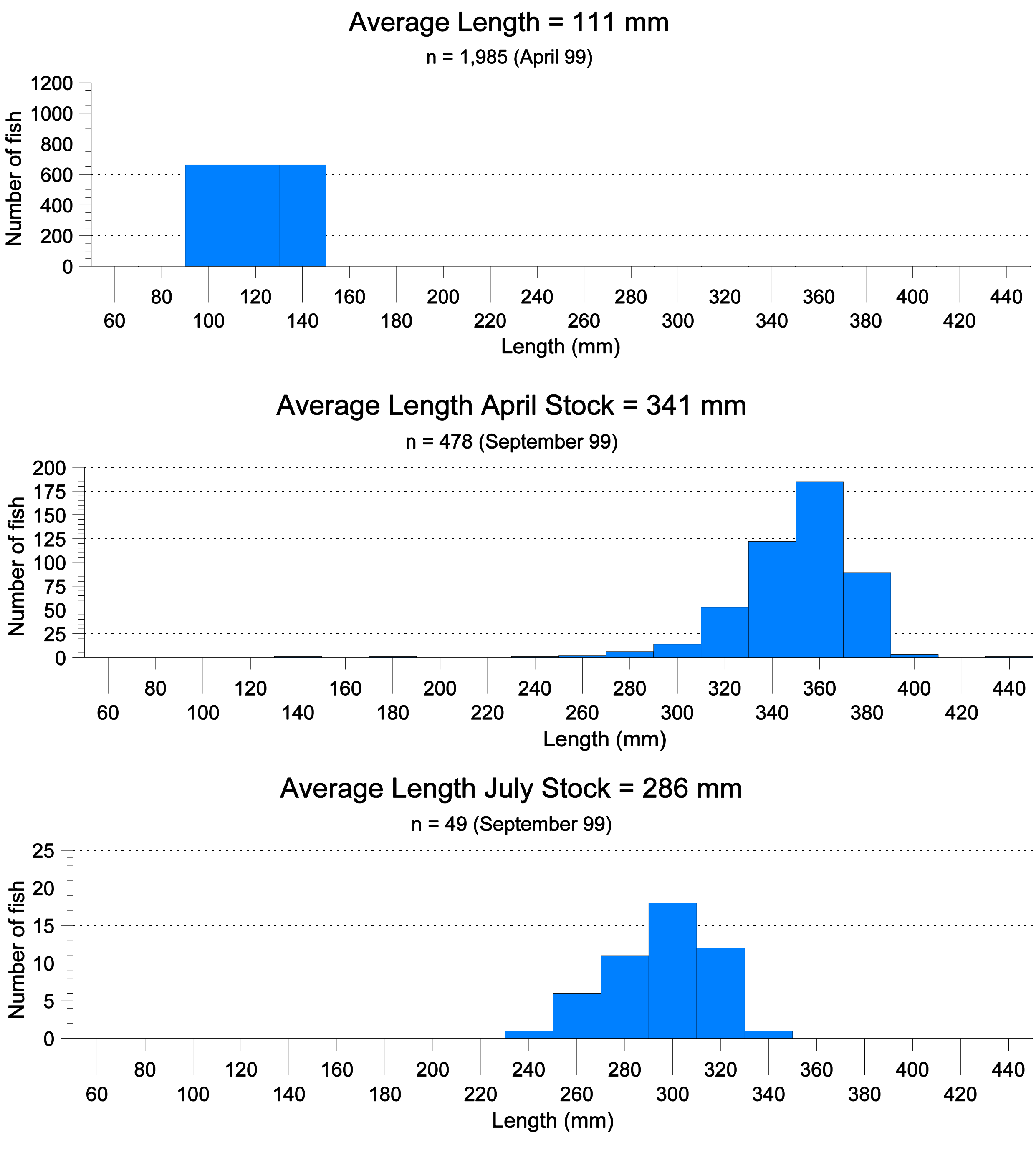


Figure 15. Length frequency at the time of spring stocking (top) and after one growing season for razorback sucker stocked into the Baeser Bend floodplain depression, Green River, Utah during the spring (middle) and July 1999 (Bottom).

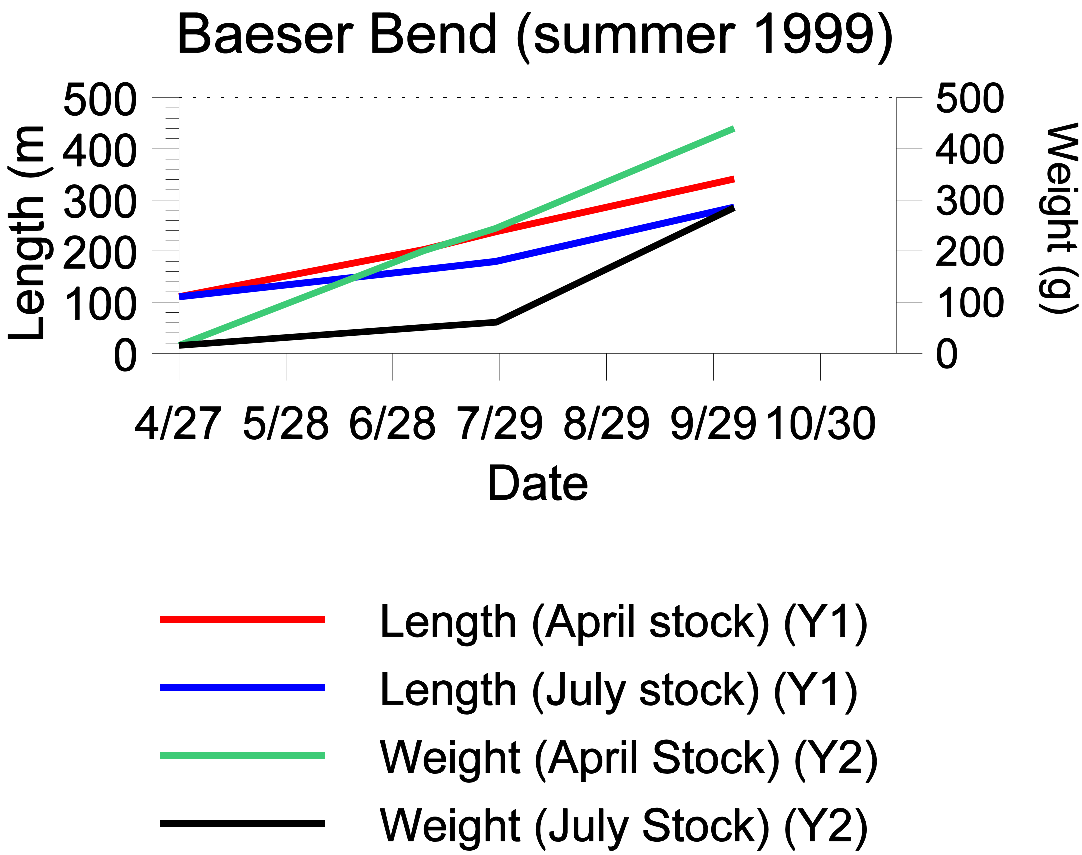
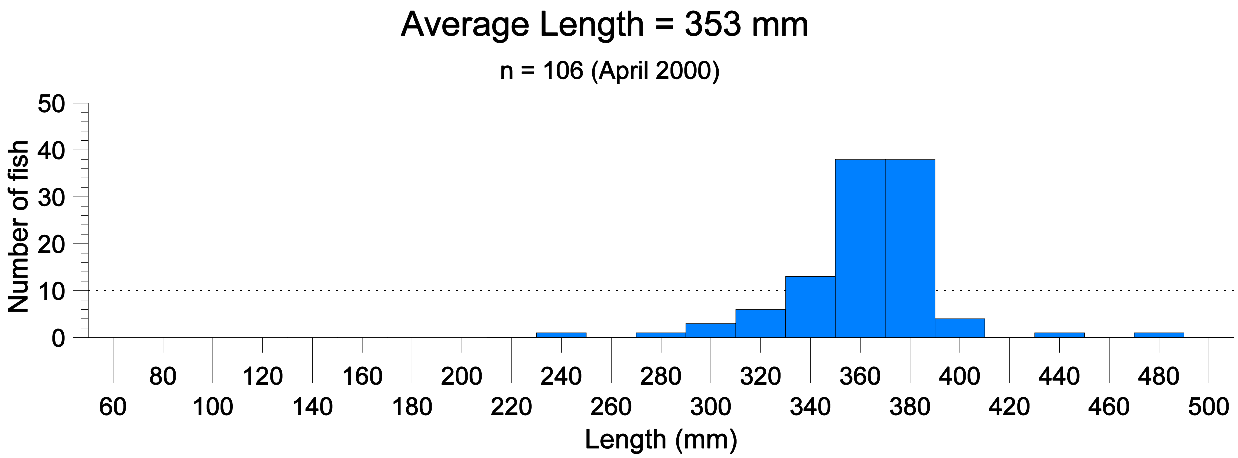


Figure 16. Linear depiction of average length and weight growth rates for razorback sucker during their first growing season in the Baeser Bend floodplain depression Green River, Utah (Note: fish stocked into the site in April averaged 1.4 mm/day and 2.7 g/day. Fish returned to the Ouray hatchery averaged 0.8 mm/day and 0.3 g/day at the hatchery and 1.5 mm/day and 1.4 g/day in the floodplain).



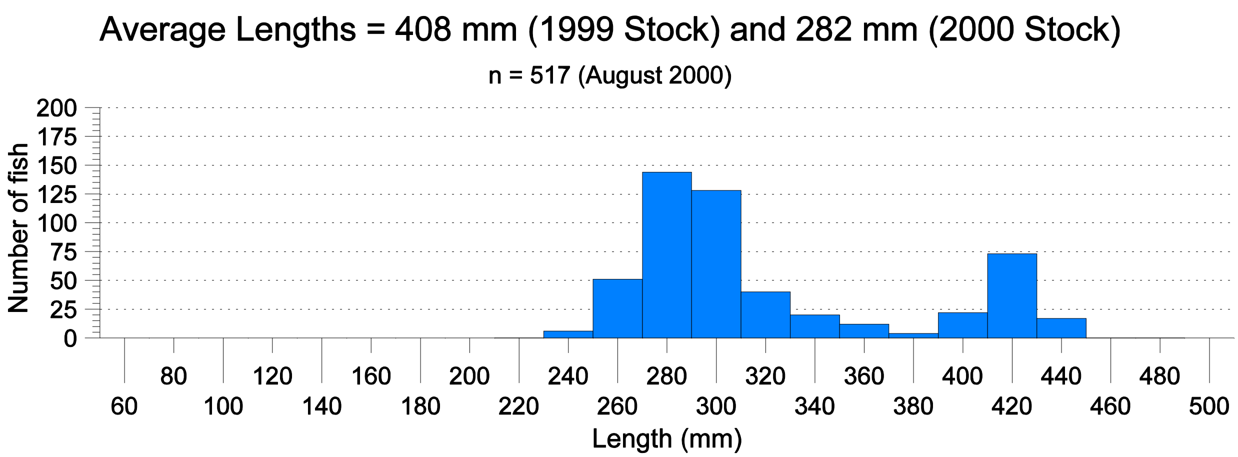


Figure 17. Length frequency for razorback sucker stocked April 1999 (top and bottom) and April 2000 (bottom) into the Baeser Bend floodplain depression, Green River, Utah (Note: top graph is only 1999 fish after one year in the site and bottom graph is 1999 and 2000 stocked fish during the 2000 growing season).

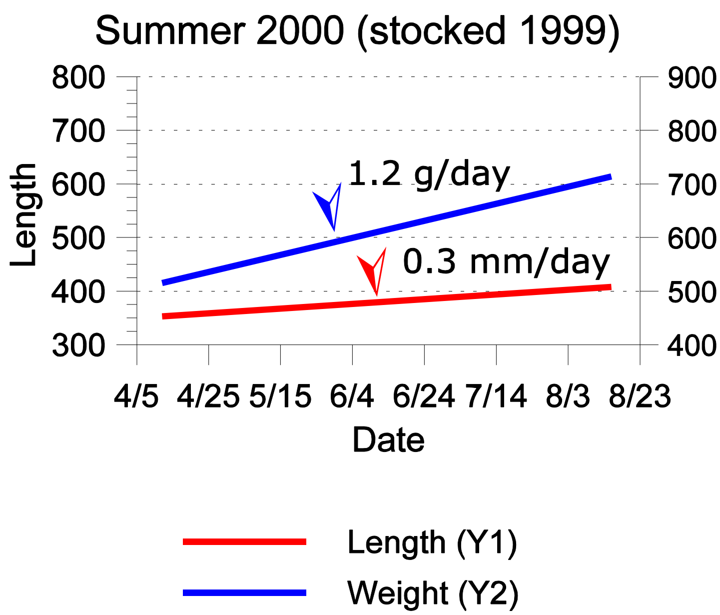


Figure 18. Linear depiction of average length and weight growth rates during the second growing season (summer 2000) for razorback sucker stocked into the Baeser Bend floodplain depression Green River, Utah in 1999.

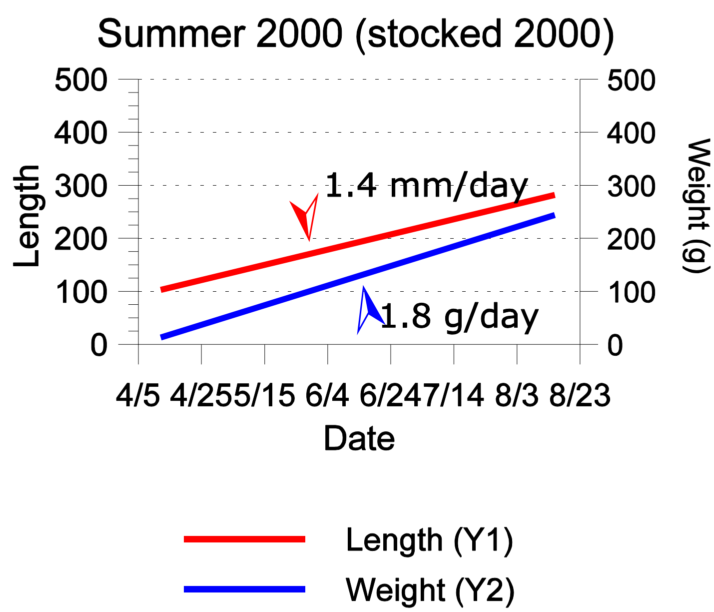


Figure 19. Linear depiction of average length and weight growth rates during summer of 2000 for fish stocked into Baeser Bend floodplain depression, Green River, Utah in April 2000.

Table 1. Summary of razorback sucker stocking data for each floodplain depression study site.

			The Stirrup		Baeser Bend		Above Brennan		
Stocking Date	Age Class	Year Class	Quantity	Density #/Ha	Quantity	Density #/Ha	Quantity	Density #/Ha	Total
5/18/99	Larval	1999	6,806		0	0	0	0	56,907
5/24/99	Larval	1999	17,568						
5/29/99	Larval	1999	7,183						
6/2/99	Larval	1999	25,350						
5/8/01	Larval	2001			25,458				
5/11/01	Larval	2001	0	0	32,782		0	0	58,240
Total larval			[a]56,907	7,296	[a]58,240	3,757			115,147
10/27/98	I	1997	125	16	0	0	0	0	125
4/27/99	I	1998	1,985	254	1,985	128	[d]1,985	120	5,955
7/28/99	I	1998	0	0	204	13	0	0	204
4/12/00	I	1999	2,511	322	2,511	162	[e]2,511	152	7,533
Total Age-1			[b]4,621		[c]4,700		4,496		13,817
Total All Fish			123,056		62,940		8,992		128,964

The fate of each group of razorback sucker that were stocked is as follows:

[a] Survival of larval razorback sucker was not detected during the study.
[b] All razorback sucker (except one) that were stocked into The Stirrup died during the 2000 summer.
[c] These fish migrated to the river, died in the summer of 2000 or were mechanically moved to the river.
[d] High probability the surviving portion of these fish entered the river during connection in 2000 and 2001.
[e] It appears these fish died shortly after stocking in 2000. The exact cause of death is unknown.

Table 2. Summary of the number of floodplain razorback sucker captured between 1999 and 2001 in breach traps while entering the river or in the Green River during sampling for other projects.

Sampling Effort	# of RZ Captured	# of Positive Floodplain RZ	[a]# of Probable Floodplain RZ	Total Floodplain RZ	[b]% Floodplain RZ
[c]Breech Traps 1999	2	2	0	2	100.0
[a]Breech Traps 2000	42	42	0	42	100.0
[d]Breech Traps 2001	0	0	0	0	0
[e]CPM Estimate 2000	41	19	4	23	56.1
[f]CPM Estimate and NP Removal 2001	115	57	12	69	60.0
[g]CPM Estimate USFWS	34	14	8	22	64.7
Total	234	134	23	158	

[a]Probable because fish were not PIT tagged and fall into the same size range of other fish positively identified from floodplain stocking.

[b]Percentage of the total razorback catch that originated from floodplain stocking.

[c]Breech trap sampling occurred at each site during the floodplain-river connection period.

[d]Breech trap sampling only occurred at Above Brennan in 2001.

[e]These razorbacks were captured by Utah Division of Wildlife (UDWR) during 2000 Colorado pikeminnow abundance estimate sampling between Island Park (Rm 334) and the White River confluence (Rm 246).

[f]These razorbacks were captured by UDWR during 2001 Colorado pikeminnow abundance estimate (Rm 334 - 246) and northern pike removal near Jensen (Rm 301.7) and Duchesne River confluence (Rm 247.9).

[g]These razorbacks were captured by United States Fish and Wildlife Service personnel between White river confluence (Rm 246) and Swasey takeout (Rm 131.8).

Table 3. Summary of capture history data for razorback sucker originally tagged in floodplain depression study sites and subsequently caught in the Green River or tributaries during 2000 sampling.

	PIT #	Location	Rkm	Rm	Rm Traveled	TL (mm) @ Capture	WT (g) @ Capture	TL (mm) Growth	WT (g) Growth
10/06/99	510D296520	Baeser Bend	439.3	273		323	463		
04/10/00		Baeser Bend	439.3	273	0.0	335	425	12	-38
06/07/00		Green River	484.0	300.7	27.8	371	595	36	170
05/30/00	[a]512763003	Above Brennan	432.0	268.4		401	663		
06/01/00		Duchesne River	0.6	0.373	20.9	400	671		
10/05/99	[a]51276B2A1	Baeser Bend	439.3	273		323	383		
05/28/00		Baeser Bend	439.3	273		377	581		
06/01/00		Green River	403.5	250.7	22.2	377	621	54	238
05/05/00	5127751B14	Baeser Bend	439.3	273		385	715		
06/13/00		Green River	447.0	277.8	4.8	384	716		
06/02/00	[a]5127784700	Baeser Bend	439.3	273		386	679		
06/16/00		Duchesne River	0.2	0.124	25.2	384	690		
10/13/99	512A613137	Above Brennan	432.0	268.4		342	430		
06/01/00		Duchesne River	0.6	0.373	20.9	365	620	23	190

[a]Fish captured in breech traps during river-floodplain connection.

Table 4. Summary of capture history data for razorback sucker originally tagged in floodplain depression study sites and subsequently caught in the Green River or tributaries during 2001 sampling.

Capture Dates	PIT #	Location	Rkm	Rm	Rm Traveled	TL (mm) @ Capture	WT (g) @ Capture	TL (mm) Growth	WT (g) Growth
10/06/99	511555446D	Baeser Bend	439.3	273		363	684		
05/16/01		Green River	498.3	309.6	36.7	423	759	60	75
10/06/99	51155C1D4	Baeser Bend	439.3	273		324	488		
05/22/01		Green River	442.5	275	2.0	395	668	71	180
05/30/00	[a]512768701	Above	432.0	268.4		364	564		
05/09/01		Duchesne	0.2	0.124	20.7	400	721	36	157
08/18/00	51276D107E	Baeser Bend	439.3	273		375	?		
05/22/01		Green River	441.7	274.5	1.5	383	583	8	?
08/29/00	5128503701	Baeser Bend	439.3	273		415	729		
05/23/01		Green River	420.6	261.3	11.6	425	833	10	104
10/13/99	[a]512A5F456	Above	432.0	268.4		353	634		
05/30/00		Above	432.0	268.4		382	585		
05/14/01		Duchesne	0.2	0.124	20.6	387	723	34	89
04/06/00	512B0B7809	Above	432.0	268.4		387	729		
05/17/01		Green River	480.6	298.6	30.2	405	738	18	9
04/10/00	512B3F2D40	Baeser Bend	439.3	273		370	621		
05/16/01		Green River	498.0	309.4	36.5	408	703	38	82
10/22/99	512B43583C	Above	432.0	268.4		286	262		
05/07/01		Duchesne	0.2	0.124	20.7	400	689	114	427

Table 4. Continued...

Capture Dates	PIT #	Location	Rkm	Rm	Rm Traveled	TL (mm) @ Capture	WT (g) @ Capture	TL (mm) Growth	WT (g) Growth
10/20/99	512B4B6050	Baeser Bend	439.3	273		355	473		
06/06/01		Green River	413.2	256.8	16.2	403	667	48	194
10/26/99	[a]512B4D1F7	The Stirrup	444.1	276		333	370		
06/02/00		The Stirrup	444.1	276		368	600	35	230
05/30/01		Green River	500.4	310.9	35.0	414	714	46	114
04/10/00	512E110516	Baeser Bend	439.3	273		364	584		
05/14/01		Duchesne	0.2	0.124	25.2	412	729	48	145
04/06/00	512C532938	Above	432.0	268.4		346	538		
3/28/01		Green River	310.9	193.2	75.2	381	700	35	162
10/22/99	512C580F31	Above	432.0	268.4		321	336		
04/09/01		Green River	368.1	228.7	39.7	398	738	77	402
04/06/00	512C5E5A64	Above	432.0	268.4		378	483		
04/02/01		Green River	206.9	128.6	139.9	385	754	7	271
04/06/00	512D06202C	Above	432.0	268.4		330	452		
04/20/01		Green River	285.9	177.7	90.8	360	521	30	973
10/22/99	512E111051	Above	432.0	268.4		327	409		
06/01/01		Green River	468.9	291.4	22.9	398	624	71	215

[a]Fish originally captured in breech traps during river-floodplain connection.

APPENDIX A

Table 5. All razorback sucker captured by UDWR, Northeast Region during Colorado pikeminnow abundance estimate sampling in the Green and Duchesne Rivers, 2000 (See Table 3 for codes).

Project	River	RMI	Rkm	Date	Sp.	TL	WT	PIT Tag #	Sex	RC	Coded Wire	CW Scan	Origin
RZ Stock	GR	273.0	439.3	10/06/99	RZ	323	463	510D296520	UI				
RZ Stock	GR	273.0	439.3	04/10/00	RZ	335	425	510D296520	UI				
CPM est.	GR	300.8	484.0	06/07/00	RZ	371	595	510D296520	UI	Y	N	N	Floodplain
RZ Stock	GR	268.5	432.0	05/30/00	RZ	401	663	*512763003C	UI				
CPM est.	DR	0.4	0.6	06/01/00	RZ	400	671	512763003C	UI	Y	?	Y	Floodplain
RZ Stock	GR	273.0	439.3	10/05/99	RZ	326	383	51276B2A1A	UI				
RZ Stock	GR	273.0	439.3	10/06/99	RZ			51276B2A1A	UI				
RZ Stock	GR	273.0	439.3	05/28/00	RZ	377	581	*51276B2A1A	UI				
CPM est.	GR	250.8	403.5	06/01/00	RZ	377	621	51276B2A1A	UI	Y	N	N	Floodplain
RZ Stock	GR	273.0	439.3	05/05/00	RZ	385	715	5127751B14	UI				
CPM est.	GR	277.8	447.0	06/13/00	RZ	384	716	5127751B14	UI	Y	Y	N	Floodplain LPC
RZ Stock	GR	273.0	439.3	06/02/00	RZ	386	679	*5127784700	UI				
CPM est.	DR	0.1	0.2	06/16/00	RZ	384	690	5127784700	UI	Y	N	Y	Floodplain
RZ Stock	GR	268.5	432.0	10/13/99	RZ	342	430	512A613137	UI				
CPM est.	DR	0.4	0.6	06/01/00	RZ	365	620	512A613137	UI	Y	?	Y	Floodplain
RZ Stock	GR	273.0	439.3	05/06/99	RZ	?	?	7F7D16430D	UI	N	N	N	Chemo-imprinted fish Radio tagged and stocked in the floodplain 05/06/99
CPM est.	GR	297.7	479.0	05/04/00	RZ	466	933	7F7D16430D	UI	Y	N	N	Floodplain
CPM est.	DR	0.1	0.2	06/16/00	RZ	389	704	5127661440	UI	Y	N	Y	Floodplain LPC new tag
CPM est.	GR	276.7	445.2	06/13/00	RZ	408	737	5127665D5C	UI	Y	Y	N	Floodplain LPC new tag
CPM est.	DR	0.1	0.2	06/16/00	RZ	405	723	51276F4D61	UI	Y	N	Y	Floodplain LPC new tag
CPM est.	DR	0.1	0.2	06/16/00	RZ	361	667	5127613E4E	UI	N	Y	Y	Floodplain (+coded wire)
CPM est.	DR	0.1	0.2	06/16/00	RZ	360	602	512763587D	UI	N	Y	Y	Floodplain (+coded wire)
CPM est.	DR	0.4	0.6	06/01/00	RZ	390	742	512765402E	UI	N	Y	Y	Floodplain (+coded wire)
CPM est.	DR	0.5	0.8	06/16/00	RZ	350	563	51276E2F3B	UI	N	Y	Y	Floodplain (+coded wire)
CPM est.	DR	0.4	0.6	06/01/00	RZ	390	699	5127701447	UI	N	Y	Y	Floodplain (+coded wire)
CPM est.	GR	249.6	401.6	06/15/00	RZ	390	716	5127724730	UI	N	Y	Y	Floodplain (+coded wire)
CPM est.	DR	0.5	0.8	06/16/00	RZ	374	619	5127747A59	UI	N	Y	Y	Floodplain (+coded wire)
CPM est.	DR	0.1	0.2	06/16/00	RZ	375	664	5127780E1C	UI	N	Y	Y	Floodplain (+coded wire)
CPM est.	DR	0.5	0.8	06/16/00	RZ	354	555	5127797147	UI	N	Y	Y	Floodplain (+coded wire)
CPM est.	GR	250.8	403.5	06/01/00	RZ	361	567	5127633D3E	UI	N	N	N	Likely Floodplain (not scanned)
CPM est.	GR	256.3	412.4	05/31/00	RZ	395	787	512B500478	UI	N	N	N	Likely Floodplain (not scanned)

Table 5. Continued......

Project	River	RMI	Rkm	Date	Sp.	TL	WT	PIT Tag #	Sex	RC	Coded	CW	Origin
CPM est.	GR	330.0	531.0	04/11/00	RZ	480	1163	512C4E670A	UI	N	N	N	Likely Floodplain (not scanned)
CPM est.	GR	330.5	531.8	04/12/00	RZ	476	1130	512C4E670A	UI	Y	N	N	Likely Floodplain (not scanned)
CPM est.	DR	0.5	0.8	06/16/00	RZ	375	604	5128476636	UI	N	N	Y	Likely Floodplain (-coded wire)
CPM est.	GR	310.8	500.1	06/07/00	RZ	426	597	1F1F642C32	UI	Y	N	N	6/22/99 Split Mtn
CPM est.	GR	315.0	506.8	04/13/00	RZ	468	913	1F657A1763	UI	Y	N	N	7/06/99 Split Mtn pit tag 1F657A176B not 3???
CPM est.	DR	0.1	0.2	06/16/00	RZ	444	978	1F68647B1A	UI	Y	N	Y	7/06/99 Split Mtn
CPM est.	DR	1.0	1.6	06/16/00	RZ	540	1801	51273C147D	UI	N	N	Y	Wild Fish
CPM est.	DR	0.4	0.6	06/01/00	RZ	520	1674	51276B1970	UI	N	N	Y	Wild Fish
CPM est.	DR	0.1	0.2	06/16/00	RZ	589	2125	51276B3135	UI	N	N	Y	Wild Fish
CPM est.	GR	299.0	481.1	04/14/00	RZ	437	826	7F7B105C32	UI	Y	N	N	6/22/99 Split Mtn
CPM est.	GR	289.7	466.1	06/08/00	RZ	440	669	7F7B105C32	UI	Y	N	N	Recapture
CPM est.	GR	295.8	475.9	05/04/00	RZ	427	777	7F7B112506	UI	Y	N	N	6/22/99 Split Mtn
CPM est.	GR	302.9	487.4	05/19/00	RZ	361	665	7F7B113823	UI	Y	N	N	10/26/98 Split Mtn
CPM est.	GR	330.0	531.0	04/11/00	RZ	380	526	7F7B1B5C18	UI	Y	N	N	7/09/99 Island Park
CPM est.	GR	282.0	453.7	06/13/00	RZ	450	621	7F7D0F3A42	UI	Y	N	N	10/20/98 Split Mtn
CPM est.	GR	315.0	506.8	04/13/00	RZ	445	884	7F7D164561	UI	Y	N	N	10/20/98 Split Mtn
CPM est.	GR	298.8	480.8	06/07/00	RZ	439	722	7F7D164561	UI	Y	N	N	Recapture
CPM est.	GR	311.6	501.4	04/13/00	RZ	553	1690	1F1F5C4C1A	UI	Y	N	N	Wild Fish
CPM est.	GR	286.4	460.8	04/20/00	RZ	293	397	5124754B00	UI	Y	N	N	??
CPM est.	GR	286.6	461.1	04/20/00	RZ	298	306	51251E7400	UI	Y	N	N	??
CPM est.	GR	330.6	531.9	04/12/00	RZ	538	1832	7F7D071951	UI	Y	N	N	Wild Fish
CPM est.	GR	309.4	497.8	04/13/00	RZ	568	2046	7F7D164C79	UI	Y	N	N	Wild Fish
CPM est.	GR	309.8	498.5	05/19/00	RZ	185	74	5125170C01	UI	Y	N	N	??

Total individual razorback sucker captured in 2000 = 41

Table 6. All razorback sucker captured by UDWR, Northeast Region and Fish and Wildlife Service, Vernal Field Office during Colorado pikeminnow abundance estimate and northern pike removal sampling in the Duchesne and Green Rivers, 2001 (See Table 3 for codes).

Project	River	RMI	Rkm	Date	Sp.	TL	WT	PIT Tag #	Sex	RC	Coded Wire	CW Scan	Origin
RZ Stock	GR	273.0	439.3	10/06/99	RZ	363	684	511555446D	UI				
CS Est	GR	309.7	498.3	05/16/01	RZ	423	759	511555446D	M	Y	Y	Y	Floodplain
RZ Stock	GR	273.0	439.3	10/06/99	RZ	324	488	51155C1D4C	UI				
CS Est	GR	275.0	442.5	05/22/01	RZ	395	668	51155C1D4C	UI	Y	N	Y	Floodplain
RZ Stock	GR	268.5	432.0	05/30/00	RZ	364	564	*512768701C	UI				
NP remov.	DR	0.1	0.2	05/09/01	RZ	400	721	512768701C	UI	Y	N	Y	Floodplain
RZ Stock	GR	273.0	439.3	08/18/00	RZ	375		51276D107E	UI				
CS Est	GR	274.5	441.7	05/22/01	RZ	383	583	51276D107E	UI	Y	N	Y	Floodplain
RZ Stock	GR	273.0	439.3	08/29/00	RZ	415	729	5128503701	UI				
CS Est	GR	261.4	420.6	05/23/01	RZ	425	833	5128503701	UI	Y	Y	Y	Floodplain
RZ Stock	GR	268.5	432.0	10/13/99	RZ	353	634	512A5F456E	UI				
RZ Stock	GR	268.5	432.0	05/30/00	RZ	387	723	*512A5F456E	UI				
NP remov.	DR	0.1	0.2	05/14/01	RZ	382	585	512A5F456E	UI	Y	N	N	Floodplain
RZ Stock	GR	268.5	432.0	04/06/00	RZ	387	729	512B0B7809	UI				
CS Est	GR	298.7	480.6	05/17/01	RZ	405	738	512B0B7809	M	Y	Y	Y	Floodplain
RZ Stock	GR	273.0	439.3	04/10/00	RZ	370	621	512B3F2D40	UI				
CS Est	GR	309.5	498.0	05/16/01	RZ	408	703	512B3F2D40	M	Y	Y	Y	Floodplain
RZ Stock	GR	268.5	432.0	10/22/99	RZ	286	262	512B43583C	UI				
NP remov.	DR	0.1	0.2	05/07/01	RZ	400	689	512B43583C	UI	Y	N	N	Floodplain
RZ Stock	GR	273.0	439.3	10/20/99	RZ	355	473	512B4B6050	UI				
CS Est	GR	256.8	413.2	06/06/01	RZ	403	667	512B4B6050	UI	Y	Y	N	Floodplain LPC
RZ Stock	GR	276.0	444.1	10/26/99	RZ	333	370	512B4D1F74	UI				
RZ Stock	GR	276.0	444.1	06/02/00	RZ	368	600	*512B4D1F74	UI				
CS Est	GR	311.0	500.4	05/30/01	RZ	414	718	512B4D1F74	M	Y	Y	Y	Floodplain
RZ Stock	GR	268.8	432.5	04/06/00	RZ	346	538	512C532938	UI	N			
USFWS	GR	193.2	310.9	03/28/01	RZ	381	700	512C532938	M	Y	N/A	N	Floodplain
RZ Stock	GR	268.5	432.0	10/22/99	RZ	321	336	512C580F31	UI	N			
USFWS	GR	229	368.1	04/09/01	RZ	398	738	512C580F31	M	Y	N/A	N	Floodplain
RZ Stock	GR	268.8	432.5	04/06/00	RZ	378	483	512C5E5A64	UI	N			
USFWS	GR	129	206.9	04/02/01	RZ	385	754	512C5E5A64	M	Y	N/A	N	Floodplain
RZ Stock	GR	268.8	432.5	04/06/00	RZ	330	452	512D06202C	UI	N			
USFWS	GR	178	285.9	04/20/01	RZ	360	521	512D06202C	UI	Y	N	Y	Floodplain
RZ Stock	GR	273.0	439.3	04/10/00	RZ	364	584	512E110516	UI				
NP remov.	DR	0.1	0.2	05/14/01	RZ	412	729	512E110516	UI	Y	Y	N	Floodplain
RZ Stock	GR	268.5	432.0	10/22/99	RZ	327	409	512E111051	UI				
CS Est	GR	291.4	468.9	06/01/01	RZ	398	624	512E111051	M	Y	N	Y	Floodplain

Table 6. Continued.....

Project	River	RMI	Rkm	Date	Sp.	TL	WT	PIT Tag #	Sex	RC	Coded Wire	CW Scan	Origin
NP remov.	GR	292.8	471.1	04/17/01	RZ	410	769	5127746176	UI	Y	Y	N	Floodplain (LPC new pit tag)
CS Est	GR	309.7	498.3	05/16/01	RZ	402	702	532460767F	M	Y	Y	Y	Floodplain (LPC new pit tag)
CS Est	GR	310.4	499.4	05/16/01	RZ	413	753	5325202344	M	Y	Y	Y	Floodplain (LPC new pit tag)
CS Est	GR	311.0	500.4	05/30/01	RZ	427	723	53255B2554	M	Y	N	Y	Floodplain (LPC new pit tag)
CS Est	GR	272.0	437.6	05/22/01	RZ	395	641	53261A1076	M	Y	Y	Y	Floodplain (LPC new pit tag)
CS Est	GR	311.0	500.4	05/30/01	RZ	386	564	53264F2404	M	Y	Y	Y	Floodplain (LPC new pit tag)
CS Est	GR	274.5	441.7	05/22/01	RZ	395	602	5326504103	UI	Y	N	Y	Floodplain (LPC new pit tag)
CS Est	GR	274.5	441.7	05/22/01	RZ	365	481	53265B7E11	UI	Y	Y	Y	Floodplain (RPC new pit tag)
CS Est	GR	311.0	500.4	05/30/01	RZ	425	697	53265C070F	M	Y	Y	Y	Floodplain (LPC new pit tag)
CS Est	GR	274.5	441.7	05/22/01	RZ	385	525	5326605863	UI	Y	N	Y	Floodplain (DPC new pit tag)
CS Est	GR	272.8	438.9	05/22/01	RZ	400	737	5326613572	UI	Y	Y	Y	Floodplain (LPC new pit tag)
CS Est	GR	311.0	500.4	05/30/01	RZ	395	631	5326625927	M	Y	N	Y	Floodplain (LPC new pit tag)
CS Est	GR	247.9	398.9	05/11/01	RZ	419	886	53266A7973	UI	Y	Y	Y	Floodplain (LPC new pit tag)
CS Est	GR	311.1	500.6	05/30/01	RZ	393	609	53266E164E	M	Y	Y	Y	Floodplain (LPC new pit tag)
CS Est	GR	278.1	447.5	05/21/01	RZ	420	698	53270C2068	M	Y	Y	N	Floodplain (LPC new pit tag)
	GR			04/25/01	RZ	405	694	NO TAGS	UI	Y	Y	N	Floodplain LPC
NP remov.	GR	247.9	398.9	04/03/01	RZ	395	695	5127650057	UI	N	Y	Y	Floodplain (+coded wire)
NP remov.	DR	0.1	0.2	04/23/01	RZ	405	725	5127761202	UI	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	292.2	470.1	04/17/01	RZ	408	812	5127612676	UI	N	Y	Y	Floodplain (+coded wire)
NP remov.	GR	0.1	0.2	05/17/01	RZ	392	675	512762AA20	UI	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	305.4	491.4	05/31/01	RZ	402	760	512770634E	M	Y	Y	Y	Floodplain (+coded wire)
CS Est	GR	306.7	493.5	05/03/01	RZ	419	820	512770634E	M	N	Y	Y	Floodplain (+coded wire)
NP remov.	GR	247.9	398.9	04/03/01	RZ	408	752	5127723A4B	UI	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	274.5	441.7	05/22/01	RZ	395	669	531C720122	UI	N	Y	Y	Floodplain (+coded wire)
USFWS	GR	190	305.7	05/08/01	RZ	425	781	53240F3155	UI	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	311.6	501.4	05/15/01	RZ	426	815	53241A370F	M	N	Y	Y	Floodplain (+coded wire)
USFWS	GR	191	307.3	04/19/01	RZ	406	793	5324224B7B	UI	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	311.0	500.4	05/30/01	RZ	415	706	53246E7968	M	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	298.9	480.9	05/17/01	RZ	397	695	53254E1901	M	N	Y	Y	Floodplain (+coded wire)
NP remov.	DR	0.1	0.2	05/09/01	RZ	395	670	53255E7468	UI	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	309.7	498.3	05/16/01	RZ	403	656	53256A3F37	M	N	Y	Y	Floodplain (+coded wire)
USFWS	GR	193	310.5	04/19/01	RZ	415	887	5325731A22	UI	N	Y	Y	Floodplain (+coded wire)
USFWS	GR	187	300.9	04/19/01	RZ	405	748	532577481D	UI	N	Y	Y	Floodplain (+coded wire)
USFWS	GR	191	307.3	04/19/01	RZ	379	695	53260E0765	UI	N	Y	Y	Floodplain (+coded wire)
USFWS	GR	190	305.7	05/08/01	RZ	405	769	53260E1B47	UI	N	Y	Y	Floodplain (+coded wire)

Table 6. Continued.....

Project	River	RMI	Rkm	Date	Sp.	TL	WT	PIT Tag #	Sex	RC	Coded Wire	CW Scan	Origin
USFWS	GR	188	302.5	04/19/01	RZ	380	636	53260F2772	UI	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	311.0	500.4	05/30/01	RZ	414	683	5326146A3C	M	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	303.8	488.8	05/16/01	RZ	417	828	5326151C02	M	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	311.0	500.4	05/30/01	RZ	417	716	53261A012B	M	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	311.4	501.0	05/30/01	RZ	395	691	53261D1B58	M	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	274.5	441.7	05/22/01	RZ	405	957	5326316807	UI	N	Y	Y	Floodplain (+coded wire)
USFWS	GR	187	300.9	04/19/01	RZ	419	863	532632142C	UI	N	Y	Y	Floodplain (+coded wire)
USFWS	GR	191	307.3	04/19/01	RZ	429	882	53263A7401	UI	N	Y	Y	Floodplain (+coded wire)
USFWS	GR	198	318.6	04/18/01	RZ	385	344	5326511A41	UI	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	304.6	490.1	05/31/01	RZ	425	709	5326521357	M	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	311.0	500.4	05/30/01	RZ	401	718	5326521579	M	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	299.9	482.5	05/31/01	RZ	435	870	5326623735	M	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	311.0	500.4	05/30/01	RZ	401	690	532663256B	M	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	311.0	500.4	05/30/01	RZ	381	632	532664594C	M	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	281.8	453.4	05/07/01	RZ	390	608	5326646177	UI	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	274.5	441.7	05/22/01	RZ	383	568	5326646177	UI	Y	Y	Y	Floodplain (+coded wire)
CS Est	GR	311.0	500.4	05/30/01	RZ	381	629	5326650B6B	M	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	313.8	504.9	05/15/01	RZ	418	685	53267D6F30	M	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	291.8	469.5	05/07/01	RZ	393	688	5327044045	M	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	288.9	464.8	05/07/01	RZ	409	708	5327074036	M	N	Y	Y	Floodplain (+coded wire)
CS Est	GR	311.0	500.4	05/30/01	RZ	397	616	53270A1838	M	N	Y	Y	Floodplain (+coded wire)
NP remov.	GR			04/25/01	RZ	405	752	5123607B46	M	N	N	N	Likely floodplain (not scanned)
NP remov.	DR	0.1	0.2	05/07/01	RZ	402	740	532554187E	UI	N	N	N	Likely floodplain (not scanned)
CS Est	GR	260.3	418.8	05/23/01	RZ	427	952	5325547A30	M	N	N	N	Likely floodplain (not scanned)
USFWS	GR	193	310.5	03/28/01	RZ	384	710	53261D4848	M	N	N/A	N	Likely floodplain (not scanned)
CS Est	GR	282.8	455.0	05/21/01	RZ	387	650	53262C7D63	M	N	N	N	Likely floodplain (not scanned)
CS Est	GR	311.0	500.4	05/30/01	RZ	409	753	5326360044	M	N	N	Y	Likely floodplain (not scanned)
USFWS	GR	152	244.6	03/31/01	RZ	384	576	53263B3830	M	N	N/A	N	Likely floodplain (not scanned)
NP remov.	GR	152	244.6	03/31/01	RZ	385	694	53265A3E7C	M	N	N/A	N	Likely floodplain (not scanned)
NP remov.	DR	0.1	0.2	04/23/01	RZ	410	680	51271A0065	UI	N	N	Y	Likely floodplain (-coded wire)
CS Est	GR	299.4	481.7	04/17/01	RZ	405	748	512737732E	M	N	N	Y	Likely floodplain (-coded wire)
NP remov.	GR	247.9	398.9	04/03/01	RZ	395	714	512841500E	UI	N	N	Y	Likely floodplain (-coded wire)
USFWS	GR	147	236.5	04/23/01	RZ	412	930	53254D1E7F	UI	N	N	Y	Likely floodplain (-coded wire)
USFWS	GR	175	281.6	05/09/01	RZ	379	670	53255C437F	UI	N	N	Y	Likely floodplain (-coded wire)
NP remov.	GR			03/22/01	RZ	420	764	53257F5D0D	UI	N	N	Y	Likely floodplain (-coded wire)

Table 6. Continued......

Project	River	RMI	Rkm	Date	Sp.	TL	WT	PIT Tag #	Sex	RC	Coded Wire	CW Scan	Origin
USFWS	GR	207	333.1	05/07/01	RZ	420	818	532622760E	UI	N	N	Y	Likely floodplain (-coded wire)
USFWS	GR	170	273.5	05/10/01	RZ	389	780	5326634432	UI	N	N	Y	Likely floodplain (-coded wire)
USFWS	GR	190	305.7	05/08/01	RZ	398	731	532666035E	UI	N	N	Y	Likely floodplain (-coded wire)
CS Est	GR	311.0	500.4	05/30/01	RZ	407	752	5326724A22	M	N	N	Y	Likely floodplain (-coded wire)
CS Est	GR	273.4	439.9	05/22/01	RZ	383	634	5327006664	UI	N	N	Y	Likely floodplain (-coded wire)
CS Est	GR	309.8	498.5	05/30/01	RZ	389	606	5327082A16	M	N	N	Y	Likely floodplain (-coded wire)
NP remov.	DR	0.1	0.2	04/09/01	RZ	578	1678	5127763035	UI	N	N	N	Wild Fish
CS Est	GR	311.0	500.4	05/02/01	RZ	432	698	1F600E2A49	M	Y	N	N	7/06/99 Split Mtn
NP remov.	DR	0.1	0.2	04/06/01	RZ	402	639	1F61012C53	UI	Y	N	N	6/22/99 Split Mtn
USFWS	GR	138	222.0	04/01/01	RZ	424	773	1F6124025A	M	Y	N/A	N	6/22/99 Split Mtn
NP remov.	DR	0.1	0.2	05/11/01	RZ	410	658	1F644D131D	UI	Y	N	N	6/22/99 Split Mtn
CS Est	GR	248.2	399.4	06/06/01	RZ	405	611	1F644D131D	UI	Y	N	N	Recapture
NP remov.	DR	0.1	0.2	04/11/01	RZ	400	635	1F64522407	UI	Y	N	N	6/22/99 Split Mtn
NP remov.	DR	0.1	0.2	05/01/01	RZ	434	760	1F647E354A	UI	Y	N	N	6/22/99 Split Mtn
NP remov.	DR	0.1	0.2	05/14/01	RZ	520	1517	1F664A5F52	UI	Y	N	N	Wild Fish tagged @ Old Charley Diked 06/08/99
CS Est	GR	311.0	500.4	05/02/01	RZ	470	1039	223F616422	M	Y	N	N	Wild Fish tagged during basinwide monitoring 06/12/98
CS Est	GR	289.6	466.0	05/18/01	RZ	530	1413	22402D1809	UI	Y	N	N	Wild Fish tagged during basinwide minitoring 06/24/98
CS Est	GR	292.8	471.1	04/17/01	RZ	452	750	5127680F53	UI	N	N	N	Wild Fish
NP remov.	DR	0.5	0.8	05/09/01	RZ	511	1430	53263F7003	UI	N	N	N	Wild Fish
NP remov.	DR	0.1	0.2	05/09/01	RZ	444	920	7F7B105464	UI	Y	N	Y	10/28/98 Split Mtn
USFWS	GR	191.4	308.0	03/28/01	RZ	445	950	7F7B11312F	M	Y	N/A	N	10/26/98 Split Mtn
CS Est	GR	311.0	500.4	05/02/01	RZ	405	686	7F7B114476	M	Y	N	N	6/18/99 Split Mtn
CS Est	GR	311.0	500.4	05/30/01	RZ	404	601	7F7B114476	M	Y	N	Y	Recapture
USFWS	GR	227	365.2	04/09/01	RZ	545	1011	7F7B120707	M	Y	N/A	N	10/28/98 Split Mtn
NP remov.	DR	0.1	0.2	05/03/01	RZ	460	970	7F7B120707	UI	Y	N	N	10/26/98 Split Mtn
NP remov.	DR	0.1	0.2	04/30/01	RZ	422	745	7F7B12454C	UI	Y	N	N	10/20/98 Split Mtn
CS Est	GR	311.0	500.4	05/02/01	RZ	430	902	7F7B124F37	UI	Y	N	N	6/22/99 Split Mtn
CS Est	GR	331.0	532.6	04/24/01	RZ	430	793	7F7B19653D	UI	Y	N	N	7/09/99 Island Park
CS Est	GR	311.0	500.4	05/30/01	RZ	405	599	7F7B1A6244	M	Y	N	Y	6/22/99 Split Mtn
NP remov.	GR		0.0	04/10/01	RZ	475	1035	7F7B1A6626	UI	Y	N	N	7/06/99 Split Mtn
NP remov.	DR	0.1	0.2	05/07/01	RZ	460	820	7F7B1B0978	F	Y	N	N	6/22/99 Split Mtn
CS Est	GR	304.3	489.6	04/16/01	RZ	500	1419	7F7D042529	UI	Y	N	N	Recaptured from basinwide monitoring 05/22/96

Table 6. Continued.....

Project	River	RMI	Rkm	Date	Sp.	TL	WT	PIT Tag #	Sex	RC	Coded Wire	CW Scan	Origin
USFWS	GR	129	207.6	04/24/01	RZ	453	972	7F7D0A6033	UI	Y	N	Y	10/20/98 Split Mtn
CS Est	GR	287.9	463.2	05/07/01	RZ	435	790	7F7D163F68	UI	Y	N	Y	10/20/98 Split Mtn
USFWS	GR	129	207.6	04/24/01	RZ	445	993	7F7D171A7D	UI	Y	N	Y	10/20/98 Split Mtn
CS Est	GR	283.0	455.3	05/21/01	RZ	421	788	7F7D176117	UI	Y	N	N	10/20/98 Split Mtn
CS Est	GR	309.5	498.0	05/16/01	RZ	470	966	7F7D17666B	F	Y	N	Y	10/20/98 Split Mtn
NP remov.	DR	0.1	0.2	05/07/01	RZ	440	850	7F7D176F43	UI	Y	N	N	10/20/98 Split Mtn
NP remov.	DR	0.1	0.2	05/03/01	RZ	455	950	7F7D176F43	UI	Y	N	N	Recapture
NP remov.	GR	299.0	481.1	05/16/01	RZ	443	831	7F7D17704E	UI	Y	N	N	10/20/98 Split Mtn
NP remov.	GR	0.1	0.2	05/17/01	RZ	445	845	7F7D223A03	UI	Y	N	Y	10/20/98 Split Mtn
CS Est	GR	311.0	500.4	05/30/01	RZ	462	814	7F7D226A66	M	Y	N	Y	10/20/98 Split Mtn
NP remov.	DR	0.1	0.2	05/14/01	RZ	560	1429	2241297938	UI	Y	N	N	? Likely hatchery 2000 stock
CS Est	GR	254.5	409.5	05/24/01	RZ	387	490	1F1F786C5E	UI	Y	N	N	? Likely hatchery 2000 stock
NP remov.	DR	0.1	0.2	05/03/01	RZ	545	1538	1F611E746E	UI	Y	N	N	? Likely hatchery 2000 stock
CS Est	GR	311.0	500.4	05/02/01	RZ	510	1399	1F720F647C	M	Y	N	N	? Likely hatchery 2000 stock
USFWS	GR	229	368.5	04/09/01	RZ	351	428	5115574856	M	Y	N/A	N	? Likely hatchery 2000 stock
USFWS	GR	197	317.0	04/18/01	RZ			512A6B3333	UI	N	N	Y	? Likely hatchery 2000 stock
USFWS	GR	235	378.1	04/05/01	RZ	371	603	512B0D572A	M	Y	N/A	N	? Likely hatchery 2000 stock
NP remov.	GR	0.1	0.2	05/17/01	RZ	384	592	512B0F4E56	UI	Y	N	Y	? Likely hatchery 2000 stock
CS Est	GR	297.5	478.7	05/17/01	RZ	346	429	512B126F55	UI	Y	N	Y	? Likely hatchery 2000 stock
CS Est	GR	294.0	473.0	05/04/01	RZ	386	652	512C7B1060	UI	Y	N	N	? Likely hatchery 2000 stock
USFWS	GR	166	267.1	04/21/01	RZ	388	703	512E1C3C41	UI	Y	N	Y	? Likely hatchery 2000 stock
USFWS	GR	226	363.6	05/02/01	RZ	394	717	5326165812	UI	Y	Y	Y	? Likely hatchery 2000 stock
USFWS	GR	190	305.7	05/08/01	RZ	392	700	53261D4848	UI	Y	N	Y	? Likely hatchery 2000 stock
CS Est	GR	311.0	500.4	05/02/01	RZ	410	667	53263B0E63	M	Y	Y	N	? Likely hatchery 2000 stock
CS Est	GR	311.0	500.4	05/02/01	RZ	470	1080	53264F6A15	M	Y	N	N	? Likely hatchery 2000 stock
CS Est	GR	332.8	535.5	05/01/01	RZ	445	836	7F7B121842	M	Y	N	Y	? Likely hatchery 2000 stock
CS Est	GR	315.5	507.6	05/15/01	RZ	452	1017	7F7B123E00	UI	Y	N	Y	? Likely hatchery 2000 stock
CS Est	GR	311.0	500.4	05/30/01	RZ	440	655	7F7B124754	M	Y	N	Y	? Likely hatchery 2000 stock
CS Est	GR	292.8	471.1	04/17/01	RZ	465	1107	7F7B124D5A	UI	Y	N	N	? Likely hatchery 2000 stock
CS Est	GR	330.9	532.4	04/24/01	RZ	435	982	7F7B13493E	M	Y	N	N	? Likely hatchery 2000 stock
CS Est	GR	332.4	534.8	05/01/01	RZ	435	875	7F7B13493E	M	Y	N	N	? Likely hatchery 2000 stock
CS Est	GR	280.9	452.0	05/21/01	RZ	435	773	7F7B135754	UI	Y	N	N	? Likely hatchery 2000 stock
NP remov.	GR	295.8	475.9	03/23/01	RZ	460	867	7F7B195A25	UI	Y	N	N	? Likely hatchery 2000 stock
NP remov.	DR	0.1	0.2	05/03/01	RZ	470	972	7F7D16354B	UI	Y	N	N	? Likely hatchery 2000 stock

Total individual razorback sucker captured in 2001 = 147

Table 7. Explanation of codes used in tables 5 and 6.

Column	Code	Explanation
Project	RZ Stock	Fish tagged while sampling for stocked razorback sucker in floodplain depression study sites
	CPM est.	Fish caught by UDWR personnel during Colorado pikeminnow abundance estimate sampling in the Green or Duchesne Rivers.
	NP Remov.	Fish caught by UDWR personnel during Northern pike removal sampling in the Green or Duchesne Rivers.
	USFWS	Fish caught by Fish and Wildlife Service, Vernal Office in the Green River during Colorado pikeminnow abundance estimate sampling.
River	GR	Green River
	DR	Duchesne River
RMI		River mile
Rkm		River kilometer
Sp.		Species
TL		Total Length (mm)
WT		Weight (grams)
PIT Tag #	*	Captured in breech traps leaving the floodplain.
Sex	UI	Unidentified Sex
	M	Male
	F	Female
RC		Recapture, Yes or No
Coded Wire		Coded wire detected in fish, Yes or No
CW Scan		Was the fish scanned for coded wire? Yes or No
Origin	Floodplain	Fish known to have been originally stocked into floodplain sites because it was previously PIT tagged or fin clipped during floodplain sampling. Also includes fish scanned positive for coded wire (+ coded wire).
	Likely Floodplain	Untagged fish captured in the river that are within the same length class as those positively identified as floodplain fish (286 - 427 mm). These fish either were not scanned for coded wire or scanned negative.
	Other	Hatchery fish with stocking date and location or wild fish.
Color highlights	Light yellow highlights date a floodplain fish with PIT tag was captured in the river. Light blue floodplain fish with fin clip but no PIT tag. Light green highlights fish that scanned positive for coded wire reading. Pink highlights probable floodplain fish but they were not scanned for coded wire. Grey probable floodplain fish that scanned negative for coded wire. Tan highlights non-floodplain razorback sucker (wild or hatchery origins).	

Table 8. Estimate of the maximum number of razorback sucker that could have entered the Green River population from floodplain stocking sites 1999 - 2000.

Total age-1 razorback sucker stocked during study (Table 1).	13,817
[a]Total mortality in The Stirrup	-4,620
[b]Spring 2000 Baeser Bend population estimate subtracted from 1999 stock (2189 - 1303 = 886)	-886
[b]Spring 2000 Above Brennan population estimate subtracted from 1999 stock (1985 - 1440 = 545).	-545
[c]All age-1 fish from 2000 in Above Brennan	-2,511
[d]age-1 fish from 2000 in Baeser Bend	-2,511
[e]Fish that died during fish kill @ Baeser Bend 2000 .	-500
[f]Fish from 1999 stock remaining in Baeser Bend following mechanical removal in 2000	-52
Estimate for maximum number of fish that could have entered the river population from this study	2,192

[a]Because of low flows only one fish entered the river from The Stirrup 4,621 - 1 = 4,620.

[b]If population estimates are accurate then 886 and 514 fish died before having the opportunity to leave these sites.

[c]Assumes all these fish died because mortality was observed from this age class after stocking.

[d]Because no age-1 fish were caught in breach traps the assumption is no age-1 fish left the site during connection in 2000.

[e]Estimated number based on count of over 300 carcasses along one shoreline after fish kill.

[f]Of the 520 fish captured during removal, 117 were from the 1999 stocking or 22.5%. There were an estimated 229 fish remaining multiplied by 22.5% = 52 fish from the 1999 stock that remained.

APPENDIX B

Water Quality Data for The Stirrup, Baeser and Brennan floodplain sites January 20, 2000

	"Depth"	"Time"	"Temp"	"pH"	"SpCond"	"Salin"	"DO"	"DO"	"Depth"	"Turb"
	"meters"	"HHMMSS"	"degC"	"units"	"uS/cm"	"ppt"	"%Sat"	"mg/l"	"meters"	"NTU"
Stirrup										
	0.20	150032	5.27	8.63	744.00	0.40	114.50	11.86	0.20	4.50
	0.20	151600	5.61	8.82	746.00	0.40	117.80	12.09	0.20	3.60
	0.30	152210	5.76	8.80	768.00	0.40	112.90	11.55	0.30	3.60
	0.60	150133	5.84	8.63	766.00	0.40	115.20	11.76	0.60	4.40
	0.70	150218	5.83	8.65	771.00	0.40	118.30	12.08	0.70	5.30
	0.90	151411	5.89	8.78	773.00	0.40	123.10	12.55	0.90	4.30
	1.00	151945	5.71	8.81	765.00	0.40	124.20	12.73	1.00	10.50
Baeser										
	0.10	155910	1.87	8.87	2144.00	1.10	99999.00	99999.00	0.10	14.40
	0.20	154734	4.22	8.29	2405.00	1.30	153.60	16.24	0.20	29.50
	0.20	155551	2.71	8.69	2629.00	1.40	191.80	21.09	0.20	14.10
	0.20	155215	2.46	8.61	2647.00	1.40	185.70	20.56	0.20	13.90
Brennon										
	0.20	163336	5.31	8.53	670.00	0.30	186.80	19.33	0.20	43.70
	0.20	163546	4.81	8.72	607.00	0.30	178.60	18.73	0.20	30.50
	0.20	164143	4.30	8.83	692.00	0.40	186.20	19.78	0.20	27.10
	0.30	165125	4.56	8.96	679.00	0.30	176.80	18.66	0.30	64.80
	0.30	165337	4.41	8.94	675.00	0.30	168.20	17.82	0.30	58.80
	0.40	164442	4.40	8.89	704.00	0.40	183.00	19.38	0.40	56.20

Levee Site and Green River Water Quality Data

	Date MM/DD/YY	Temp degC	pH units	SpCond uS/cm	Salin ppt	DO %Sat	DO mg/l	Depth meters	Turb NTU
STIRRUP									
	07/14/00	23.63	9.52	904	0.5	129.9	8.86	2.4	99.2
	07/14/00	24.03	9.58	909	0.5	151.8	10.28	0	92.8
	07/14/00	24.3	9.59	904	0.5	151.3	10.19	0	71.2
	07/14/00	24.41	9.59	905	0.5	154.7	10.4	0	56.2
	08/14/00	24.65	8.7	1212	0.6	111.3	7.41		
	08/14/00	23.27	8.77	1197	0.6	51.7	3.54		
	08/14/00	26.24	8.99	1219	0.6	75.9	4.91		
	08/14/00	24.96	8.98	1206	0.6	101.7	6.73		
	08/14/00	23.75	8.95	1208	0.6	72.7	4.93		
BAESER									
	07/14/00	24.91	9.65	719	0.4	158.3	10.55	0.5	66.7
	07/14/00	25.94	9.78	728	0.4	180.2	11.78	0.1	52.3
	07/14/00	25.86	9.79	727	0.4	182.3	11.94	0.1	43.5
	07/14/00	26.03	9.81	724	0.4	179.1	11.7	0.1	30.5
	08/14/00	30.42	9.01	957	0.5	192.3	11.57		
	08/14/00	26.99	9.1	960	0.5	164	10.48		
	08/14/00	29.55	9.15	949	0.5	174.3	10.64		
	08/14/00	29.33	9.08	948	0.5	183.9	11.27		
BRENNAN									
	07/14/00	24.66	8.25	513	0.3	74.2	4.97	0.6	49
	07/14/00	24.7	8.25	513	0.3	71.5	4.79	0.5	46.3
	07/14/00	24.65	8.25	513	0.3	67.9	4.55	0.5	43.1
	07/14/00	25.8	8.33	513	0.3	87.9	5.77	0	19.9
	07/14/00	25.81	8.33	514	0.3	86.4	5.67	0	13.1
	07/14/00	25.78	8.34	514	0.3	87.8	5.76	0	4.8
	08/14/00	27.61	8.07	588	0.3	81.6	5.16		
	08/14/00	27.44	8.07	590	0.3	73.7	4.68		
	08/14/00	27.42	8.07	588	0.3	76.1	4.83		
	08/14/00	27.6	8.08	585	0.3	78.1	4.94		
	08/14/00	27.41	8.08	588	0.3	77.4	4.92		
	08/14/00	27.49	8.08	585	0.3	74.6	4.73		
	08/14/00	27.37	8.07	587	0.3	73.5	4.67		
	08/14/00	27.56	8.07	584	0.3	73.4	4.65		
RIVER									
	08/14/00	**23.82**	**7.6**	**667**	**0.3**	**101.3**	**6.86**		
	08/14/00	**23.83**	**7.79**	**667**	**0.3**	**99.6**	**6.75**		
	08/14/00	**23.84**	**7.82**	**667**	**0.3**	**99.4**	**6.73**		
	08/14/00	**23.85**	**7.89**	**670**	**0.3**	**99.4**	**6.73**		

Baeser overnight water quality monitoring 8/17 - 8/18/00

"Date" "MMDDYY"	"Time" "HHMMSS"	"Temp" "degC"	"pH" "units"	"SpCond" "uS/cm"	"Salin" "ppt"	"DO" "%Sat"	"DO" "mg/l"	"Turb" "NTU"

81700	150000	24.77	9.4	972	0.5	184.2	12.25	0
81700	160000	24.56	9.44	930	0.5	99999	99999	0
81700	170000	24.56	9.44	929	0.5	99999	99999	0
81700	180000	24.48	9.41	920	0.5	99999	99999	0
81700	190000	24.36	9.5	901	0.5	99999	99999	44.1
81700	200000	23.95	9.45	887	0.5	99999	99999	81.6
81700	210000	23.58	9.43	945	0.5	99999	99999	63.5
81700	220000	23.27	9.42	940	0.5	99999	99999	82
81700	230000	23.07	9.39	931	0.5	99999	99999	105
81800	0	22.74	9.35	928	0.5	195.5	13.51	76
81800	10000	22.53	9.33	923	0.5	187	12.97	85.3
81800	20000	22.28	9.3	927	0.5	176.8	12.33	62.4
81800	30000	21.91	9.28	926	0.5	169.3	11.89	82.4
81800	40000	21.63	9.25	923	0.5	158.2	11.17	74.4
81800	50000	21.14	9.24	925	0.5	151.9	10.82	80
81800	60000	20.81	9.22	928	0.5	141.3	10.14	84.9
81800	70000	20.35	9.19	929	0.5	134	9.7	79.5
81800	80000	20.24	9.19	930	0.5	128.6	9.33	0
81800	90000	21.01	9.21	931	0.5	129.5	9.25	0
81800	100000	22.9	9.3	926	0.5	135.1	9.31	0

Brennon 8-31-00 Water Quality

"Date"	"Time"	"Temp"	"pH"	"SpCond"	"Salin"	"DO"	"DO"	"Turb"
"MMDDYY"	"HHMMSS"	"degC"	"units"	"uS/cm"	"ppt"	"%Sat"	"mg/l"	"NTU"
83100	10000	22.72	8.13	627	0.3	76.3	5.48	31.5
83100	20000	22.43	8.11	627	0.3	76.4	5.53	27.2
83100	30000	22.25	8.07	626	0.3	72.6	5.27	26.6
83100	40000	22.02	8.03	627	0.3	68.3	4.97	29.9
83100	50000	21.78	8	627	0.3	65	4.76	31.1
83100	60000	21.57	7.98	627	0.3	62.6	4.6	30.6
83100	70000	21.31	7.93	628	0.3	58.1	4.29	33.3
83100	80000	21.28	7.91	628	0.3	57	4.21	0
83100	90000	21.37	8.01	627	0.3	64.2	4.74	0
83100	100000	20.32	7.81	2.5	0	104.9	7.92	2

Log File Name : BRENNAN

9-20-00

Date MMDDYY	Time HHMMSS	Temp degC	pH units	SpCond uS/cm	Salin ppt	DO %Sat	DO mg/l
92000	161500	20.83	8.29	665	0.3	91.5	6.82
92000	171500	21.43	8.38	668	0.3	102.1	7.53
92000	181500	21.08	8.41	668	0.3	104.7	7.77
92000	191500	19.97	8.44	667	0.3	104.1	7.89
92000	201500	19.74	8.44	667	0.3	104.3	7.94
92000	211500	19.46	8.44	666	0.3	101.6	7.79
92000	221500	19.19	8.43	666	0.3	100.2	7.72
92000	231500	18.95	8.44	666	0.3	98.9	7.65
92100	1500	18.63	8.41	665	0.3	95.6	7.44
92100	11500	18.29	8.39	664	0.3	93	7.3
92100	21500	18.04	8.36	663	0.3	88.7	6.99
92100	31500	17.81	8.32	664	0.3	83.4	6.61
92100	41500	17.62	8.3	664	0.3	81.9	6.52
92100	51500	17.39	8.28	665	0.3	80.2	6.41
92100	61500	17.22	8.26	665	0.3	78.9	6.32
92100	71500	17.07	8.24	665	0.3	76.8	6.18
92100	81500	16.91	8.23	665	0.3	76.9	6.21
92100	91500	16.84	8.24	665	0.3	76.2	6.16